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JOHN JONES, PHISITION

THE SECOND WRITER ON PEDIATRICS IN ENGLISH *

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Rapidly scanning the July issue of "Mercurius Britannicus"[1] on its arrival a few months ago, I was astonished to light upon an item headed: "On Child Nursing and the Education of Children" by a certain "John Jones" dated 1579. A prompt search through Ruhräh's "Pediatrics of the Past" and Still's "History of Pediatrics" revealed that here was a discovery apparently overlooked by both.

The full title of this rare book is: "The Arte and Science of Preserving Bodie and Soule in Healthe, Wisedome, and Catholike Religion: Phisically, Philosophically, and Divinely devised: By John Jones, Phisition," from all of which one can readily understand how little possibility there was of recognizing therein a book on the child's nurse and the training of children.

To a bookish neophyte like myself the price of such a treasure was just naturally prohibitive, so that my next thought was how at least to see the book. Only three other copies were recorded in the

* This study is made possible by the generosity of the Huntington Library, San Marino, California, which supplied Leica negatives of an entire book.

[1] No. 40 of "Mercurius Britannicus or Mercuries Swift Messenger, Being a Monthly Bulletin of English Literature and History prior to 1800," a bookseller's catalogue issued by Maggs Bros., Ltd., London, which gives so much important information and illustrations of the rare books listed, that it forms an important bibliographical item in itself.

"Short-Title Catalogue,"[2] all of which were confined in British libraries. There is, however, another issue listed in the Henry Huntington Library at San Marino, California. This differs from the others in that the name "Ralph Newberie" instead of "Henrie Bynneman" is in the imprint, while "Henry Bynneman" still remains in the colophon. This unique specimen is the only copy to be found in America.

A short friendly correspondence, then, and through the beneficence of the authorities in that great citadel of books, I soon had a complete photographic copy from cover to cover for study at home at my own leisure.

John Jones, "Phisition" as he styled himself, was apparently a Welshman by birth, although the exact dates of his birth and death are unknown. He mentions curing a person at Louth in 1562; and the date of this, his last publication, is 1579.[3] Near the end of this volume he states that he has "lived upon his practice by lawful grace of the Universities and had no other maintenance but it for these one and twentie yeeres." This would place the year of his "license to practice" at about 1558. In 1572 he is said to have resided near Nottingham, England, and also at Kingsmead near Derby.[4] Although both Oxford and Cambridge are believed to have been his universities, he is believed to have taken a degree in physics at Cambridge. Aikin, in his Biographical Memoirs, lists six works by John Jones, although several of these apparently were issued together. Any of his works are rarely met with.[5]

John Jones was the second Englishman to write on pediatrics. In 1545 Thomas Phaer published the first work on diseases of children ever written by an Englishman.[6] Seven editions of his book appeared prior to the issuance of John Jones' book. The only previous works on the subject in the English language were transla-

[2] Short-Title Catalogue of Books Printed in England, Scotland and Ireland 1475-1640 compiled by A. W. Pollard and G. R. Redgrave, London, 1926.

[3] Aikin, John: Biographical Memoirs of Medicine in Great Britain, London, 1780, p. 155.

[4] Dictionary of National Biography, New York, 1892, vol. 30, p. 122.

[5] Dr. Joseph Lyon Miller, the genial American authority on 16th century English medicine, nestling in the hills of Thomas, West Virginia, has two quarto books written by the same author.

[6] Still, George Frederick: "History of Paediatrics," London, 1931, p. 108.

tions from the German of Roesslin's Rosegarten, which was really a treatise on obstetrics and the management of the new-born. According to George Frederick Still, no other book on this subject was written in English for over a hundred years but this learned pediatrician was apparently unaware of John Jones' book so effectually disguised by its theological title.

While "The Arte and Science of Preserving Bodie and Soule" is not particularly original and for the most part recants former writers' opinions, as is the usual custom of all medical authors, the book has historical interest from many angles. General ideas of the time concerning the care and training of children, both physical and spiritual, as well as the sources of these beliefs are recorded. Besides frequent references to the usual ancient authorities such as Hippocrates, Galen and Avicenna, the most frequent contemporary writer mentioned was Montuus.

Hieronymus Montuus practiced in France and was physician to Henry II. In 1558 he published a book entitled Halosis Febrium, the third part of which has its own title-page: De Infantium Febribus, which deals with most of the diseases of children as known in his time.[6] The late Dr. George Frederick Still did not have the high esteem of Montuus' pediatric knowledge, however, as did our own author, Dr. John Jones.

Most important, perhaps, is the fact that John Jones, having been the second Englishman to write on the subject in his natural tongue, was a pioneer in the field of English pediatrics. As such his book merits our more careful attention.

The title-page of the Newberie imprint differs not only in the name of the printer, but, whereas the title of the Bynneman imprint contains the words "in Healthe," etc., this one has: "in al Health," etc. The border designs of the title-page, while essentially alike, on careful scrutiny prove to be not identical.

In the "Epistle Dedicatorie To The Moste high, excellent, and renowned Princesse, Elizabeth, by the Grace of God Queene of England, France and Ireland, Defendour of the faith and in earth under God of the Church of Englande and Irelande Chiefe Governoure," the prolix author expounds his basic premises. His astro-

[6] *Ibid.*, p. 132.

logic leanings are revealed by this statement: "The course of the orbe and Planets running, ebbing and flowing of waters: Bathes, Springs and Havens: blowing and whirling of Windes: ingendering of Comets, blazoning Starres and Meteors: encrease of mineralles, growth of Plants, sense in beastes, and the reason in mankinde do sufficiently declare the Motion."

As to choice of title he explains: "The Science or Doctrine of this firste Booke, work or age, as it is termed of the Greekes not farre amisse, Paedetrophia: So I entitle it, not altogether improperly, The Arte and Science of preserving Bodie and Soule." Following the dedication covering nine pages, there are forty-five chapters divided into three sections: Sectio Prima including chapter I to XVII, dealing in the main, with the child's nurse; Sectio Secunda, chapter XVIII to XXVIII being devoted chiefly to the baby, while Sectio Tertia, the remaining chapters, attempts to cover the educational and spiritual training of the child. There are in all 123 pages of subject matter followed by a table of contents giving all the chapter headings in two and a half pages.

The first chapter is a sort of prologue on: "What writers ought to consider, and wherefore the Author hath made this worke," wherein he states, "I will presentlye (according to the reverende rule of Phisicke) shew what kinde of nurse is beste to provide for infantes, (so) that younglyngs endued with the humaine graces or spirites, the naturall, vital, and animall actions, vertues, powers, or offices may have those kept in them healthyly."

The greatest stress from the beginning of the book throughout its entire contents, is placed upon the theme: "a sound body goes with a sound mind." Here, he states, (if we omit his verbigerous wanderings which so confuse the modern reader): "For this is certain, that unlesse there be a like addition added to the natural parts answerable to every age,—and a framing of the mind in al godly knowledge and holy religion, by instruction: neither can there be a sound bodie long kept, nor at al a vertuous and religious soule found, except it be by inspiration."

Chapter II is captioned: "Howe the nurse must be chosen, and which is beste." The peculiar reasoning by which the ancients made their philosophy conform to common sense is brought out in the following passage:

" The nurse that must be gotten, shal be chosen as sayth Hippocrates, Galen, Aetius, Montanus and Mokerus, according to the temperature of the babe. For if the child shall be of a perfite constitution, it must be kept by the like, or be amended by the contrarye, according to the principle which teacheth, that the healthy are to be kept by the like, the unhealthy with unlike."

A rather round-about explanation of why the nurse must be healthy no matter whether her charge be in perfect health or not.

Emphasis is placed, of course, on the superiority of mother's milk over that of any stranger, for he states:

" Hence many wise men—have judged the mothers milk best for every one. And agreeable it is to reason, that that which in the healthy wombe used it by the navill, after the safe deliverie being translated to the owne sound pappes should best nourish it by the mouth."

This passage alluded to a prevalent belief that in the last months of pregnancy, the milk was carried to the uterus and to the fetus. This idea obtained up to the middle of the eighteenth century.

The usual indications for deciding on a wet nurse are outlined:

" Weaknesse, sicknesse, lacke of milke, travell, or being againe quickly with childe," although warning is given to " the mothers as well of Princes, Noble and worshipfull children, as of the Merchaunts and commoners ought alwaies, (although they wold never so wishly) nurse their Babes themselves in England, let Syr Thomas Moore affirme it to be never so usual with every dame in Utopia."

As to the qualifications of the nurse the specifications of Aetius and Paulus Aegeneta are outlined.

In Chapter III are given " The Age, favour and manners of the Nurse."

The author recommends the age between 23 and 33 although he admits that Galen accounts 35 to be the best age. Only the original can give the full flavor of his quaint style.

" The nurse shall be full of favour, a comely coloured, as willeth Eucarius, and therewith faire, broade breasted, and wel neckt, as sayeth Galen, without gogle eyes or looking a squint say I, as she that is not separated from goodnesse."

There follows a long-winded philosophical dissertation to prove

that beauty and brains may be present in the same woman. Other characteristics to be studied in the prospective nurse are then outlined. He finally reaffirms that: " the farther any shall decline from this, the worse is their temperature, and according to the nature of the nurse wil be much inclined that which is nourished, as Aristotle, Galen and Montuus shewe, and as following (by example) shall be proved."

The belief was held by many up to quite recent times that mental and moral traits of character were influenced by the character of the woman who suckled the child. That the idea was common in the time of Dr. John Jones is shown also by the following passages from Shakespeare:

> He is my son, ay, and therein my shame,
> Yet from my dugs he drew not this deceit.[7]
> Thy valiantness was mine, thou suck'dst it from me.[8]

Chapter III deals with: " How to know the temperature (Temperament or Constitution) of the Nurse and Milke."

" Milk must be swell, of pleasant smell, white in colour, in substance mean between thick and thin. Evil milk is either thick and cheesy, or watery and wheyey, or blue and leaden, or in taste sour, harsh, rough, salty, bitter or sharp, or in smell ungrateful."

The fact that Aristotle favored blue colored milk to white is laboriously explained away by proving that he meant only that of some particular peoples or places.

Colostrum is thin and therefore considered unwholesome, but the author dared to disagree with preconceived authority when he argued against Avicenna who did not allow the infant to nurse for two months after the delivery, and with whom Gordonius did agree. In the fifth chapter reasons are given " why nurses are to be changed." The indications are: " illness or any infection, given to drink or any other intolerable vice, leste the child suck up sicknesse and wickednesse with the milk as old Hippocrates proveth."

The following examples are cited to prove this claim:

" Lanpridius writeth that Titus sonne to Vespasian, by reason that he sucked a woman of a sickly state, was himself of a sicklie

[7] King Richard Third, Act II, Sc. 2.
[8] Coriolanus, Act III, Sc. 3.

nature all his life. Dyon likewise the Greeke, testifyeth, that the incredible crueltie that was in Caligula, of Monarches the monster, issued from Pryscilla his nurse, who was of such a barbarous nature, that she delighted in licking of bloud. Also in the life of Tiberius, it appeareth that his great drunkness came through his nurse and her education, who as she was greatly given to drinke, so would she give soppes in wine to her suckling, which after it came to yeares, never left his conditions."

Our author himself claims to have seen in North Wales a lamb suck a goat and a kid suck a ewe and the one was more hairy, the other more wooly. "So that it is clearer than midday that each creature sucks with the milk some properties of the Dame."

In the next Chapter (VI) he treats "Of the best milke and what Teates be good, and which both grieve and deforme the child, and that do cause it to be unquiet."

Although Avicenna wrote that "the milke of that nurse will be beste that hath brought forth a man child" and Montuus "that hath brought forth a woman child" our worthy author compromised with: "it seemeth best for the male the mates milke, for the female the females."

The properties of a good breast are that it should not be deformed, "of mean bigness, white, with fair blue veins." He thought that "through sucking of great breastes, the children are made flat or crooked nosed." More practical was his advice to the nurse, while the child sucked, to depress her breast with one finger above the teat and the other underneath.

In the next chapter the powers of music to quiet the baby are extolled. "The best nurses, but especially the trim and skilfull Welch women, doe use to sing some preaty Sonets, wherewith their copious tong is plentifully stoared."

As an example the following is quoted from Pontanus "rather for the manner, than the glee of the matter":

What Babe is this? to
hide thy pappes,
O Sis make no delaye,
Oh cover them and hide them,
he would snatch thy dugges away.

Come hither Tomsie pretie boy,
he maketh haste, come you,
It is thine owne, takte in thy mouth,
and thou sir sucke anew.

To some such sophisticated lullaby as this the future Queen Bess may have had her turbulent spirits quelled.

Much length is devoted to the qualifications and salutory attributes of the nurse; but if we bear in mind that this book was primarily intended for the high and mighty dames who practically always employed substitutes to raise their offspring, the importance of the subject becomes at once apparent.

Certain virtuous songs and psalms were also recommended for the wet nurse in order to still any light affections, for all unmoderate passions while giving suck were to be eschewed. Intercourse was forbidden because it might provoke the menses, change the quality of the milk or result in conception.

"Furthermore Rabbi Moyse (Maimonides) affirmeth, that throughe the lust of leacherie the bloud is corrupted, and therefore Montuus councelleth that the desires thereof be repressed with the use of Lettuce, conserve of water Lillies and Pigeons eaten, strowing also the bed and chamber with Brione, and Tutsans (as Amatus Lusitanus willeth)."

Following admonitions against intemperance in eating, instructions as to exercise of nurse and child as well as the hygiene of the nursery are discussed. "Holesome" air was to be found in "places free from standing waters, and quickly dispatch of the cloudes at night"; (i. e., where the humidity was low). Ireland is praised as a healthy place where longevity was prevalent.

Later the author states that it "may be added forth of Merula by the authority of Montuus that the pleasant seate, fine building, and clean keeping of the nurserie, hath not a little avayled to the benefite of the body and minde, for that was the only cause (sayeth hee) that the Athenians were wiser and healthyer than the Thebanes."

The succeeding three chapters are devoted to the diet of the nurse. After arguing that "evil iuyce" is dependent as much upon the nature of the receiver as upon that of the substance eaten, the subject is discussed more in detail.

"The nurse's food should . . . leave no corruption in the stomache, leaste from hence evil humours might be ingendered, causing evil milke, through which, (as Galen testifyeth) he saw a certain infantes bodie replenished with ulcers, as I and other Phisitions see dayly."

Chapter XV treats of "How ware nurses must be in taking of medicines, that they marre not themselves and the childe also through advise of unlawful practitioners."

That quacks abounded then as now can be readily seen from the following quotation:

"If she (the nurse) happen at any time to be over solible or over costive, she shall not without counsel of the learned and expert Phisition, send to the Pothicarie nor take forthwith violent medicines of every presuming practitioner that offereth himself each where, vayne Paracelsian, tatling dame, and only or named Chirurgion, or Apothicary, that intrude themselves into this facultie, which of al other, is most noble, learned and excellent, every where now a dayes too common, and too shamefully suffred, not only by the Censures of Phisick, but also of the Prelates, Judges, and Justices: unlesse there be no accountes to be made of their othes, (oaths), nor regarde to the princes lawes, destruction of the people, or consideration of the maintenaunce that to so needful and worthy men shal ensue, if such blinde bittels, flattering fellowes, trotting trolles, and wilfull murtherers, be permitted not only to robbe the common wealth, slaunder the arte, and prolong diseases, but also to take the benefite due to suche as therein by our lawe are for their merite worthily admitted, learnedly commenced, and by our Universities approved, and that have taken othe to deal justly therein."

There is a modern note in this cry of our Elizabethan regular against the harassing competition of those not fairly qualified.

In listing a large group of mildly laxative herbs, vegetables and fruits there is nothing ordered that a conservative pediatrist today would hesitate to advise.

The problem child is intelligently discussed in the chapter headed: "Of the kindnesse and love that should be in a Nurse, and of the requiting thereof. A supposition whence often times the strife betweene childe and the mother doth arise." The statement that:

"Many judgeth that the causes of unkindness, disobedience and unlawful sutes arise because mothers fail to nurse their own children" is a belief that has held up to very recent times. Nursing is supposed to have increased the natural love between mother and child.

The "things naturall," i. e., the physico-chemical constitution, as we would say in more modern jargon, are listed as elementes, complexions, humours, members, powers, operations, and spirits and for further knowledge of the subject the reader is referred to the author's previous work in "Bathes Ayde." Dr. Jones, a strong protagonist of the ancients, is repeatedly at odds with Paracelsus.

To be present at the birth he advised "a fewe rather of goodlye, experte and learned women, than a rude multitude."

"The infante if it weepe a little, then (as sayeth Avicen) it shal not be unholesome, nor to many fathers irkesome, but rather joyfull newes, the case in our common law is evident. And good if it licke a little honny before it sucke after it be bathed or washed.

And in this, sayeth Montuus, we differ from our elders, for we neyther sprinkle them with salte (as Galen and Avicen willeth, and as by Ezechiel it appeareth) the Jewes used, nor spred on them mirtle leaves, (as Gordonius appointeth).

But our manerly midwives doe washe them in a Bathe of warme water, of Clemens Alexander commended, for foure especiall causes: that is to wit, warmnesse, clenliness, helth, and pleasauntnesse. And of Hippocrates for a great helpe unto growsomnesse, largenesse, and talnesse. Which Bath if it containe ten partes of running water, and one of new milke from the cowe, and have a fewe malowes put in before it be set on the fire to boyle, or a little Sallet oyle after it be taken off, when it is but lukewarme, in my judgement that wil be best, or for lacke of Sallet oyle, sweete butter, as some of the finest sorte forth of the cities and townes do use. And when you have trimmed it up, wipe it with very soft clothes, ayred or through dried. Then sucke up the foreheade, or forfronte of the tower and Ampier of Reason and Sapience, overclasping your handes before and behinde upon the rounde heade, treasurer of al Science and Knowledge. After clense the common Emunctuaries or purging wayes, as the eyes beholders of things celestiall, and witnesse of

things terrestriall: the eares triers of tongs and times: the nosethrils clensers of the braine, judgers of smelles, and receyvers and deliverers also of the windes: opening also gently the mouth, loking if it be free of tong the glorifyer of God, tryer of tastes, and Ambassadour between man and man: proving also if it wil emptie the bodie. Then lay it uppon your lappe, faire, tender and strait, placing every limme and joynt right, for as yet it will be as pliant as waxe for all good forme. And cut not of the navill string as Ezechiel sayth the Jewes did, but knit it with a throede fast, and annoint it with oyle of Roses, or sweete butter, and let it fal away of it selfe.

Nowe if you be desirous of a patterne of the finest shape, as you have alreadye noted of the beste temperature, this following is of the beste forme, according to the judgement of Policletus, Plinie, Vitruvius, and Montuus, whom I followe most of all other, yet not as a translatour, but as a collectour. And by the three dimensions Geometricall it is tryed sayeth he, that is by length, breadth, and thicknesse, beginning firste with the heade as the worthyest part, bycause it is the Tabernacle and mansion of the immortall soule, of science and all understanding, and of art before al the artes the inventor, as writeth Hippocrates, Plato and Cicero, unto whom Galen doth subscribe, Clemens Alexandrinus, S. Augustine, Melancton, and Vasselius, with Columbus, Fuchsius, Fernelius, Paparilla, Ballinger, and Banisterus, which head, if it agree with the waste in compasse, as our Prince doth with his subjectes in unity, then it is right. And the face, of miracles the mirror, if it contain from the upper part of the forehead to the lowermost part of the chin, declarrer of fruitfulnesse or barrenesse, the tenth part of al the length, it is just. And it is divided into three equal portions: that is, from the uppermost part of the foreheade to the neathermost part of the browes: from the neathermost part of the browes to the neathermost part of the Nosethrils. From the neathermost part of the Nosethrilles, to the neathermost part of the chinne. All whiche portions of the face described, agreeth with the hande, from the ende of the longer finger to the wrest, and is also the length of the foote."

Other measurements given are: "the greater bone of the thumb is equal to the size of the mouth wide open; and also to the distance

between the point of the chin and the lower lip; the lesser bone is of measure with the mustaxe, which is the space between the nose end and the upper lippe, whence the heare groweth, that nowadays is so muche chearished of Galants." The greater bone of the long finger is equal to the breadth of the forehead.

The length of the nailes are the fourth part of the length of the fingers; the thumb is equal in length to the little finger, the other two of equal length, the middlemost of the greatest length.

Chin to crown of head is ⅛ the length of the entire body, the height equal to the distance between the fingertips of the outstretched arms.

In short, he concludes, with "seemelye forme must be hadde a goodlye bodye," and further on, "nature doeth ever make the forme of the bodye meete and agreeable to the manners of the minde." This he repeatedly asserts; namely, that a sound body is necessary for a sound mind.

Considering it as trifling with the Lord's will and superior skill he inveighed against the Dames using "instruments and trickes of their owne trifeling and toyish invention, as Brasers, Wastes or bodies, made eyther of paper bordes, plate, or Cardes, ec. to make them slender although by nature they be framed rounde and handsome." . . . "thereby they shorten their childrens lives, in hindring as well natures operation by bringing diverse obstructions and infirmities to the parts, but also causeth forth most stinking breathes, copper faces, redde noses, riveled skinne, tawnie colour, and lesse fruitfulnesse."

He does advise, however, sufficient clothes to protect the child "for colde is enimie to growth" and, with Galen, warns against immersing the new-borne baby in cold water, a practice he also condemns on the part of the old Priests baptising the infant at its christening. Then follows a lengthy socio-theological discussion on the subject of illegitimate children, and the grasping selfishness of the rich.

Breast milk is advised as the only nourishment until the first teeth appear, which he stated to be at about the seventh month. He then stated that he had seen the first teeth appear, however, at a year, sometimes more and sometimes less. The fact that Richard the

thirde was born with teeth he accounts as an undoubted token of the murder and tyranny that followed. If the teeth are fewer or slenderer than normal, life is believed to be shortened, yet he mentioned that Tranquillus wrote that Augustus Caesar had but few teeth, and those slender and sharp, yet lived to be 76 years of age.

He warned against too frequent nursing as making the baby stuporous, its belly to swell and the urine too watery, and, on the authority of Montuus said that Avicen advises only two or three nursings daily. He related of the Alborages that they "had a custome that such as should be Priests, might not sucke of the breaste, but of certain reedes that yielded a juice like milke"; but he confessed that it is hard for anyone to define the "just quantitie and qualitie" of a child's food and preferred to take a chance on a little too much rather than too little. Above all he preferred that the child should "sucke the breaste than by anye other meanes be brought up."

The nurse must keep clean the bed, nursery and apparel, bathe the infant daily and change its clothing.

After Galen, he thought 3 years the best time of weaning although Paulus advised weaning at the age of 2, Gordonius at 3 years, and Montuus at 4 years. But, he continues, Eucharius and Mokerus say that custom has brought weaning to 1 year. The author himself nursed up to his third year, and was none the worse, so he says, albeit his mother was 52 and upward when he was born. He even remembered that he was able to carry a stool for his good Nurse when he wanted to suck. "Notwithstanding, I do not appoint every one to sucke so long." Those who ought particularly to suck longer he listed as: the child of an old mother, the weak child, the sickly, a twin, the male and the noble born.

"Pappe" is advised first at the seventh month, at meal time after the baby is washed and rubbed.

Chapter XXIIII treats "Of the maner howe to make the beste Pappe, of the use and abuse thereof: and howe the meane dyet is beste."

"Take of newe milke a pinte, put therein of fine wheate flower, so much, as being boiled, will make it thicke, adde to it the bignesse of a Chestnut of Almond Butter, or of sweete Butter, one ounce of

the best Sugar not faulted * in the *sunning*, and then it will bee the better to digest, and the refuse not tourned to the nourishment of the bodye, the sooner and easier emptied."

The advantages of a cradle are that sleep is sooner obtained, the baby thereby better exercised and safer than in bed, but immediately after nursing violent rocking may induce vomiting or might even induce the stone gravel or gout.

A long discussion of the physiology of sleep then ensues.

Children should sleep longer than adults. To further sleep he entailed beds, rocking and lulling, darknesse, silence, softness, warmness, weariness, and clean clothes. The nurse should not be disturbed or her milk would be affected. The infant should be changed from side to side but not placed upon its back or else the food might slide before it was perfectly digested into the urine, wayes and joynts causing the stone, gravell and gowts. The light should not be placed to the side of the child or he might become squint-eyed. The author strongly advised against all forms of clowning and dandling the infant.

" When the child awakes, it should be cleaned and washed, with breast milk, if there be plenty, for by this means the children will not only be free from chafing but will also be endued with fair color and delicate skin." If used too often, it might cause " water wheales." In handling, it should not be held by the arms or legs and the child should not be encouraged to walk too soon or else it might get hurt, crooked legs or " out shouldered."

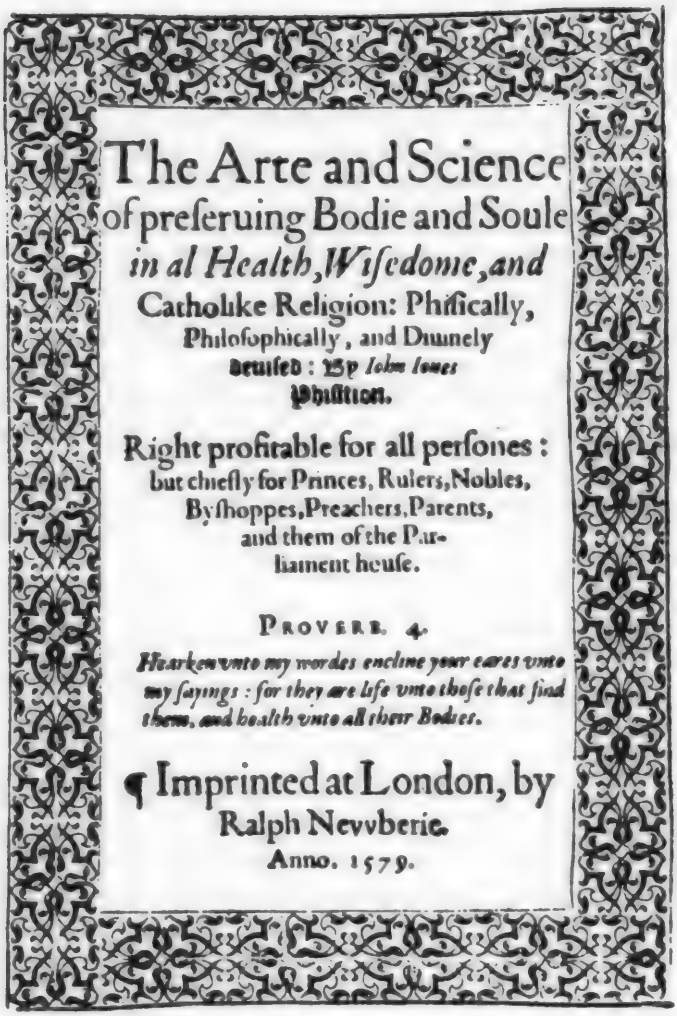
Food or nourishment more solid than Pap should be given a good while before weaning, but during dentition only pap is best. First, fine bread soaked in milk, then bread and sweet butter rather than bread and sugar; then good broth and finally tender, juicy flesh, first minced, all should be gradually added to the diet. Ale is approved, but all wines are interdicted.

Following this precise and excellent exposition of the care of the new-born follows a long-winded, random discussion of ethics and conduct. As soon as the child could talk and understand he was to be instructed in religion. " Children should not be forced to learn by too much threatening and over many strokes, for that may be

* Soured by the sun.

daunting to infantes of their feeble corages and a dulling of their weak wits." Thus was the author a worthy forerunner of John Locke. Further on he stated: "Play in time and place convenient should not be forbidden but allowed as much as possible for joy and sport give power to strength, stir up nature and prolong life, profiting all such as be whole" (i. e., in good health).

Safeguards for the playground are carefully enumerated and Bishops are cautioned in the choice of tutors, to pick those that have the knowledge of the "Diatetike part of Phisicke." Chapter after chapter is devoted to religious discussion. This was the period of strife in England between the many protestant faiths and Catholicism, following the break with Rome by Henry VIII. A strong argument is presented for the preservation of the "holye Catholike faith" and an attack against the Puritans launched, the author firmly believing in the virtues of right pleasures and lawful pastimes and their furtherance of good health.


The Arte and Science
of preſeruing Bodie and Soule
in al Health, Wiſedome, and
Catholike Religion: Phiſically,
Philoſophically, and Diuinely
deuiſed: By *Iohn Iones*
Phiſition.

Right profitable for all perſones:
but chiefly for Princes, Rulers, Nobles,
Byſhoppes, Preachers, Parents,
and them of the Par-
liament houſe.

PROVERB. 4.

Hearken vnto my wordes, encline your eares vnto my ſayings: for they are life vnto thoſe that find them, and health vnto all their Bodies.

¶ Imprinted at London, by
Ralph Newberie.
Anno. 1579.

Figure 1. Title Page.

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Chap. xxi.

That the childe muſte only ſucke vntil his former teeth appeare. The office of them. And at what time they commonlye come, with the number and forme that be required. And how the decreaſe of the teeth ſheweth, that the world draweth haſtily to an ende.

THe yongling if it be ordered, (as you haue harde it) ſhall be time to giue it ſucke, which ſhall only be his nourishment vntil his former teeth be breede, the firſt inſtruments of diſgeſtion, and framers of pronunciation, not made by chaunce, happe, or fortune, but by the prouidence of the wiſeſt euen the almightie, as Ariſtotle and Galen affirmeth. To whome the ſayde Galen conſecrated thoſe his diuine workes of the vſe of the parts, as enimies to his euerlaſting praiſe and glorie. By that famous clearke doctor Smith at his Anotomies ſo excellently and cunningly diſcribed.

The office of the teeth.

a Phiſ. 2. de vſu part.

Galen.

Smith.

And theſe teeth will be brought forth aboute the ſeauenth moneth, as Herodotus, Aetius, and Montuus do witneſſe.

At what age children breade teeth.

Notwithſtanding I haue often noted it otherwiſe, as a yeare firſt, ſometime three quarters, ſometimes more, ſometimes leſſe, ſomtimes before they be born, as Boſwels ſon had of Lawth, & Richard the thirde being vndoubted tokens of the murther and Tyrannie that after in time ſucceded, as Moore witneſſeth. But the fewer they haue, and the ſlenderer they be, the ſhorter of life, as ſayth Ariſtotle. Yet Tranquillus writeth that Auguſtus Cæſar had but fewe, and thoſe ſlender & ſharp, notwithſtanding he liued 76. yeares, whereby we are taught not alwayes to conecture with the Philoſopher by the ſlenderneſſe and fewneſſe of teeth, ſhort life.

b Plin.

H. And

Figure 2. Specimen Page.

Reproduced by permission of The Huntington Library, San Marino, California.

THE TABLE.

VVherin a good common vveale consisteth: and howve the Gentiles as vvel as Christians had allurements and meanes to drawe men thereunto: A question vvhy Christ suffered: That God is no lesse iuste than he is mercifull: Howv Princes take their regiment from God, in that they punishe the euill, & aduance the good: The frutes of the Spirit declared: The vvorkes of the flesh described: Oure Sauiours Sermon vppon the mount touched: That the Morall lawe is continuall, and in some parte the Iudiciall, but not at all the Ceremoniall: Howve all men be created to do good vvorks: A briefe conclusion vppon the drifte of thys vvhole vvorke: That euerye Countrey is to liue vvithin the limmes of their owne lawes. Chap. 43.

VVho ought to rule Youth, and vvhy: A breefe recitall of the faultines of the braine: And howve that lustie and courageous more prone to Youth than to Age. Chap. 45.

The power of the soule defined: Adams fall declared: The lawes or Israelites lesse, notvvithstanding the lawe of Moses: VVhat marreth manye, albeit they be Christians: Of diuers charitable deedes done of late, as vvell as of olde, The difference that is betweene them that fauoure Vertue, and the that further vice, although they bothe professe Christe. Chap. 44.

To vvhom the Author submitteth all his trauels: The duty of Diuines: Promise made at their consecration, &c. of their liuinge, vvith the manner of theyr liues: And of Simony. Chap. 45.

VVhat foode and doctrine the Apostles deliuered: And in vvhat the Sum of the Scripture doeth consiste: And vvho enetye after Saint Augustine shal possesse the Kingdome of Heauen. Chap. 46.

FINIS.

IMPRINTED AT LONDON,
by Henry Bynneman.

Cum Priuilegio.

Figure 3. Colophon.

Reproduced by permission of The Huntington Library, San Marino, California.

ISAAC CARDOSO, DOCTOR, PHILOSOPHER AND POET

AUGUSTO D'ESAGUY, M. D.

" The most remarkable works by Spanish authors of the period are those devoted to the study of fevers, the principal figures in this field of research being: Gomez Pereira, Luis Mercado, Cipriano Maroja, Cristobal de Vega, Nuñez de Llerena, Ponce de Santa Cruz, Isaac Cardoso," says Garcia del Real, in his translation of Garrison's *History of Medicine*.[1]

He afterwards[2] tells us that " Valles may be compared to the Portuguese Jew, Isaac Cardoso, author of *Philosophia Libera*, a most decided and energetic opponent of the Aristotelian cosmology."

Then, " Cardoso was born in Lisbon at the dawn of the XVIIth century and, like his brothers in faith Amato Lusitano and Rabbi Zacuto, practiced medicine at Valladolid and Madrid. He renounced his religion and adopted the name of Ferdinand on embracing Catholicism, but later reverted to his former faith, proceeded to Venice and became a member of the Jewish Academy of that town, dying soon after at Verona."

Was Isaac Cardoso a Spaniard or a native of Lisbon? Let us try to clear this geographical confusion straightaway.

Cardoso, a very distinguished member of his profession, and physician to Philip IV of Spain, was not a Spaniard nor yet a native of Lisbon. He was born at Celorico de Basto,[3] a town in the northern province of Minho, in the year 1615.

He was a brother of Miguel (also known as Abraham) Cardoso, likewise a doctor, practicing at Leghorn.[4]

Isaac Cardoso graduated in Medicine and Philosophy at the University of Salamanca, settled in Valladolid (1632), and was

[1] Vol. II, p. 440.

[2] P. 447.

[3] Celorico was also the cradle of the poet Miguel da Sylveira, author of *Machabeus*. Vid. Pinho Leal, *Portugal antigo e moderno*, Vol. III, 1874.

[4] Miguel Cardoso was physician to the Bey of Tripoli. There are Cardosos in Venice to this day. Vid. *Antroponimia Portuguesa*, by J. Leite de Vasconcelos, Lisbon, 1928, pp. 166, 415, and *Memorias da Litteratura Portugueza* by Ribeiro dos Santos.

afterwards appointed Chief Physician to the Spanish Court. A few years later, however, we find him a fugitive, crossing Spain like a common criminal, hiding now here now there, living his own tragedy, not knowing what lay before him yet unwilling to turn back!

And why should this famous doctor have fled the Spanish Court?

The most painstaking biographers of the author of *Philosophia Libera* have not yet succeeded in finding a satisfactory answer to the question.[8]

We think, however, that fear of the Inquisition was not the principal factor in his sudden decision to leave the country, and that a fierce inner struggle, stimulated by a re-awakening of his ancient faith, demanded that he practice his religion openly, a dangerous procedure in Spain, and urged him to seek his brother.

Cardoso's healing methods and highly successful cures had given him a unique and enviable position at Court. He was the medical adviser and friend of the King, Dukes, and Princes; he was held in high esteem by his colleagues who never tired of singing his praises and acknowledging him their master, seeing in him a writer with a remarkably clear vision who practiced in broad daylight and abhorred secret methods. There was nothing in his tranquil life to oblige him to take the sudden decision of giving up fame and benefits, friends, patients, pupils and admirers, a Court which produced noblemen often pointed out as models of virtue, who encouraged and befriended the artists and scientists who flocked to Madrid and lent it a halo of civilization.

Overcome by the violence of his inner struggle, Cardoso dispensed with all these advantages!

We find the doctor devoting himself entirely to his practice, to teaching, to the publication of his theories, thus achieving many triumphs; and then, suddenly, we see the philosopher overcome by a religious restlessness, swept away by the imperative inner need for God, groping in a mystical penumbra, feverishly seeking in his own existence the key to his surroundings, and falling into a state of meditation so deep and engrossing that it separates him completely from his friends and associates.

[8] Silva Carvalho, *Médicos e Curandeiros*, p. 46, supposes "he fled from Spain for fear of the Inquisition."

Cardoso [6] had never got involved in religious disputes; the Inquisition, strange to relate, had passed by his door and followed the trail of other victims it considered worthier of its attentions.

Had a friend warned him that yet another plot was being outlined and woven in the shadows? Everything was possible in the tumult of religious controversy which has made the XVIIth century odious to the Jews.

Was his brother a party to the rapid decision and precipitate flight of Philip IV's physician? Was it the call of kin?

This is the most obscure point in his whole life. It is reasonable to suppose, however, that Cardoso, returning with longing and zeal to the religion of his forefathers, should seek surroundings favourable or at least not hostile to the practice of that religion. The only thing we know for certain is that he left Spain without regret, his eyes eagerly searching distant spaces in the hope of finding the ragged horizon which should satisfy his tortured and restless soul, that the charming old-world landscape of Venice was powerless to capture or retain. . . .

* * *

The work of Isaac Cardoso is very vast and may be divided into two parts: medical and philosophical. The principal volume in the latter is *Philosophia Libera*, the first half of which deals with the history of philosophy, which Cardoso comments in the second half, enriching it with new conceptions which confirm his racial characteristics. Of his medical works, *De Febri Syncopali* is the most complete.

According to Kayserling,[7] Isaac Cardoso published the following works:

Discurso sobre el monte Vesuvio,[8] Madrid, 1632;
De Febri Syncopali, Madrid, 1634;

[6] *Medicos Eminentes de Portugal*, by A. Muñoz, Madrid, 1911, p. 17. "Besides medicine, he devoted himself to theology, philosophy and literature, and wrote very pleasing poetry."

[7] *Romanische Poesien der Juden in Spanien.*

[8] "In December 1631, one of the most violent eruptions of the Vesuvius took place, which had been quiet since the year 1500. The crater ejected such an enormous quantity of cinders, that part of them are said to have fallen over Constantinople. 5000 people lost their lives as a result of this eruption." Schnurrer, *Chronik der Seuchen*, Tübingen, 1824, Vol. II, p. 172.

Si el parto de trece y quatorce meces es natural, Madrid, 1640;
Oracion funebre en la muerte de Lope de Vega Carpio,[9] Madrid, 1630;
Del Origen del Mundo, Madrid, 1633;
Panegyrico del Color Verde, Madrid, 1635;
Utilidades del agua i de la nieve, Madrid, 1637;
Philosophia Libera, Venice, 1673;
Excellencias y Calunias de los Hebreos, Amsterdam, 1678.

Silva Carvalho[10] catalogues the same works, pointing out it was the last-named which made him famous.

Very little is known of Cardoso's death, but most of his biographers are of the opinion that he died at Verona in 1680.

* * *

Discurso sobre el monte Vesuvio and *Utilidades del Agua i de la nieve, del Bover frio i Caliente* have been described in detail by Gallardo.

In the Lisbon National Library there is a copy of *Oracion funebre en la muerte de Lope de Vega Carpio.*

In his introduction to that rare work, *Utilidades del Agua i de la nieve*, Guttierrez de Solorzano, Court Physician, says, p. 4:

" He displays a great skill and prudence in dealing with ice and cold drinks, and when his views go against prevalent opinion, he avoids a heated argument with much tact and elegance. . . . He describes in masterly fashion the various uses of hot drinks in olden times."

Although Cardoso's book was the first by a Portuguese author entirely devoted to the study of liquid diet, this subject is already discussed by Garcia da Orta in *Colóquio de Melan* and by Rodrigo da Fonseca (1615), who prescribes cold water to abate fevers.

Cardoso belongs to the school of Hippocrates, Avicenna, Mercado and Pedro Garcia.

Other Portuguese doctors who have described the proper and

[9] Dedicated to the Duke of Sessa.
[10] *Médicos e Curandeiros.*

improper uses of water in the treatment of certain diseases are: Estevão Rodrigues de Castro, 1656, Curvo Semedo, 1697, João Mendes Sachetti Barbosa, 1758, and last but not least Jacob or Henrique de Castro Sarmento in *Siderohydrologia ou Discurso Practico das Agoas Mineraes Espadanas ou Chalybeadas*, London, 1726.

Sonsa Viterbo infers from Cardoso's dedication to Jacob Pinto in *Las Excellencias de los Hebreos*, that he was "influenced by racial atavism" or perhaps by a sub-conscious yearning which urged him to exalt the idea of God, the powerful ferment which drew him irresistibly to Verona and to conversion (March 17, 1678).

This is not the sole revelation of the strange magnetic force which attracted Cardoso to Judaism, urging him to give up everything: a brilliant and well-paid position, honours, apparent tranquility, unusual opportunities, royal friendships, a large practice and an enviable income.

Other Jewish or Marrano masters of Portuguese birth, some exiled, others welcomed at the Portuguese or Spanish Courts, which protected them from the least attack or surprise, left all those advantages, drawn by the same powerful magnet, and, braving all sorts of danger, crossed countries agitated by religious controversy, to take refuge in the Portuguese communities of Amsterdam, London or Hamburg in the hope of finding there, among their own people, a true conception of God, a resting-place and real peace of mind.

The conscious had bound them to the new religion, bidding them first take stock of advantages and honours, many of which were the outcome of their compulsory conversion, then holding up as contrast the horrors of the Inquisition cells or the stake with its greedy flames, sparing neither life nor wealth.

At a given moment, however, racial atavism or neurosis, an urgent appeal from the deepest unconscious zone, brought about a strange revulsion of feeling. The entreaties of their most devoted friends, patiently trying to impress on them the advantages they were giving up, were powerless to deter them. Their longing for God was stronger, their fear of torture and of the stake, a thing of the past. . . .

* * *

Cardoso, a remote disciple of Francisco Sanches, the father of Portuguese philosophy,[11] was at the same time a very finished poet, proving the truth of the Portuguese saying that *Poetry is not incompatible with Science.*

He is the perfect type of restless thinker moved by gigantic forces which only death could overcome. *Philosophia Libera*, written in marvellous style, contains a record of that fierce struggle, the real tragedy of his life.

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[11] The principal medical monographs by Francisco Sanches are: *De febribus et earum symptomatibus*, and *Morbis internis*; his chief philosophical work, *Quod nihil scitur.*

VTILIDADES
DEL AGVA I DE LA NIEVE,
DEL BEVER FRIO I CALIENTE.
AL ECmo Sor CONDE DVQVE
El Dotor Fernando Cardoſo
Offrece, Dedica, Conſagra.
CON PRIVILEGIO.
En Madrid por la viuda de Alóſo Martin, Año 1637.

Fig. 1.

Frontispiece of *Utilidades del Agua i de la Nieve*. 14.5 x 9.5.

Siderohydrologia:

OU

Diſcurſo Practico

DAS

Agoas Mineraes Eſpadanas, ou *Chalybeadas*;

Em que ſe moſtra

Sua Natureza, Compoziçao, Methodo de as beber, e os Achaques, em que ſaõ Convenientes.

Pello Doutor *H. de C. S.* Medico do Real Collegio da Cidade de *Londres*.

LONDRES,

Impreſſo por *J. Humfreys*, para o Autor. 1726.

Fig. 2.
Frontispiece of Castro Sarmento's work.

TEXTS AND DOCUMENTS

OFFICIAL "EDICT" BY THE CITY OF ZÜRICH, SWITZERLAND, 1766 A. D.

On the Methods of Resuscitation to be Employed on Drowned or Asphyxiated Persons

With a Brief Introduction

BY

Arno B. Luckhardt, M. D.
(The University of Chicago)

It was my good fortune to see recently in connection with a meeting of The American College of Surgeons a most interesting and instructive historical exhibit on "The Evolution of Resuscitation" prepared by Dr. Hart Ellis Fisher, Chief Surgeon of the Chicago Rapid Transit Company, Chicago, Illinois. An article with the same title recounted in a paragraph or two and in chronological order the various maneuvers which were employed to restore life to those who were apparently dead from drowning, from the inhalation of toxic gases, electric current, etc., etc.

Van Eysselsteijn wrote on the same subject extensively in a technical and critical manner years ago,[1] as did Cary[2] a year later. Neither of these articles are illustrated; nor do they have the appeal on the practical side of Fisher's illustrated historical resumé.

But none of these reviews gave me a real insight into the common practices of *a given period* and the reasons therefor until there fell into my hands a small 8-page pamphlet *published* in Zürich, Switzerland, about the time that Lavoisier was proving to the scientific world the real role of the recently isolated element and gas, oxygen, in its relation to life and living processes. As will be no-

[1] Die Methoden der künstlichen Atmung u. s. w. by Dr. G. van Eysselsteijn, Berlin, Julius Springer, 1912, p. 122.

[2] A Brief History of the Methods of Resuscitation of the Apparently Drowned, by R. J. Cary, M. D., Johns Hopkins Hospital Bulletin, vol. 24, pp. 243-251.

ticed, this " edict " was the result of an action taken by the Chancery Office of the City of Zürich on April 26, 1766, in other words, *before* the isolation of oxygen by Priestley and Scheele in 1771 and again and independently by Lavoisier in 1775.

In the hope that others might enjoy it to whom it is not readily available, I have prepared the fairly literal translation appearing in the ensuing pages. A reproduction of the title page of the German text is included as well, in the interest of those readers who treasure historical documents of a medical character.

Anleitung

wie

denen Ertrunkenen

zu Rettung des Lebens dienliche Hülfe

zu leiſten.

Auf

Hoch-Oberkeitlichen Befehl

zum Druck befördert.

Anno 1779.

Instruction on the Manner In Which One Can be of Help In Saving the Life of the Drowned

Published at the Command of the High-Magistrates
In the Year, 1779

Experience has shown that the drowned which were considered dead and that lay for some time under water have often been restored again and kept alive by proper maneuvers. From which one rightly concludes that life has not been completely suspended in the drowned but that there is hope to save them from death if, as soon as they are withdrawn from the water, prompt and careful help is administered. And, the love for mankind should stimulate everyone to do everything to save these unfortunates.

One must see to it that the stomach and chest (lungs) are freed from water and froth, that the natural warmth of the body is restored to it, that the parts of the chest necessary for life are brought into motion, that the blood is brought into circulation and that thereafter the body is provided with necessary strength.

To accomplish this one must:

1. Remove or cut from the body, as soon as withdrawn from the water, all of the wet clothes and then cover it with dry and if possible with warm clothes, or wrap it in covers.

2. To get rid of the swallowed water and froth from the lungs, the drowned person should not be stood on his head as is the prevalent custom, since this furthermore conspires towards a deleterious tendency of the stagnant blood towards the filled head. The water is more easily removed if the abdomen is pressed towards the chest, either with the hands, or if one lays the body with its belly over a round wood or barrel so that the head lies flat in front and that the feet hang down in back; if the head is held in this position and the body then shaken, water, mucus, and froth usually pass off. It is useful also to blow tobacco smoke through mouth and nose. If the mouth is open, the pharynx can be irritated with a feather soaked in oil to promote vomiting.

3. One should not continue at this too long but make provisions to warm the body. If the location is at some distance from dwell-

ings, a fire can be started, cloths can be warmed, and the body can be rubbed and then covered with them.

Or, if in the summer the drowned person is taken from the water at a place or near a place where sand has been heated by the summer's heat, one can put the body in it and cover with same.

The imparted heat of a person, who was determined and kind enough to lie in bed with the drowned person and so envelope him with his naturally warm body, has brought motion and life in the drowned.

But in cold weather every precaution is to be taken, that the body be not exposed to the cold, but that it be placed immediately on its belly on a wagon or wheel barrow, or, in the absence of the latter, on a board or ladder or in any other convenient manner, and brought to the closest dwelling where the person is put into a warmed bed and rubbed from the nape of the neck along the whole length of the spinal column, as well as also on the arms and the legs with woolen or rough cloths soaked in either warm wine, or cloths smoked with the smoke of juniper berries, and the soles of the feet rubbed with brushes. Even beating of the soles of the feet has saved some lives.

Or, if it is possible to order a warm bath, the drowned person is put into it, and the rubbing is continued. Or, one strews into the bed warmed ashes to the extent of 3 or 4 inches, or if no bed is available, on the floor, put the naked body in it, strew the ashes over the body, and cover it with bed clothes or cloths.

4. In the meantime, one must not neglect to stimulate the body, particularly the lungs, stomach, and intestines in all possible ways.

For this purpose tobacco smoke is preeminent if it is blown often into the lower body;* one has for these dry tobacco-clysters, particular appliances and an instrument, but since they are seldom at hand, one can do this job quickly and easily in the following manner. One takes an earthen tobacco pipe, or a wooden one, the kind that many of our farmers always carry around with them in a sac but from which the lid must be broken off, one, a good span long, dulls the sharp edge of the stem, fills the bowl a little more than half full with tobacco and after the latter has been lighted and

* Per rectum.

has been burning well (by smoking heavily) one covers the opening with a handkerchief or perforated paper, pushes the stem up the rectum, and blows in the smoke into the rectum until the tobacco is all consumed. Or, one blows through a similar stem or narrow spool in a similar manner the tobacco smoke which one has first drawn from another pipe into the mouth. Or, one can introduce sharp clysters consisting of one ounce of salt, one dram of pepper, one dram of ginger, and one pint of warm water.

At the same time one can blow tobacco smoke through the mouth and nose.

If the mouth is open it is appropriate to blow air into it if someone present pinches off the nose, puts his mouth tightly over the mouth of the drowned and then blows hard.

If the mouth is closed, one tries to pry open and keep open the mouth with a knife blade or a piece of hard wood suitably whittled for the purpose, and then to stimulate one can put in a small spoonful of table salt, or, one can squirt in some warm water mixed with salt, butter, and oil; or, as already noted above, one can stimulate the fauces with a feather to produce vomiting.

It is useful also to blow snuff into the nose through a quill or other tube. Similarly, one can allow the smoke of burning feathers, hair, or horn to arise into the nose.

5. When the body is warmed up and all other methods of stimulation have been continued, phlebotomy may be of great value if done by a skilled surgeon on the jugular vein to free the oppressed brain from the accumulated blood.

6. One must not spare effort to continue these therapeutic measures for some time, even for one or two hours, because many instances have shown that the desired result often occurs after one or more hours.

In case this does not happen, one heroic measure is still available, namely to have a skilled surgeon open the trachea and have air blown through the opening.

7. After the drowned has been resuscitated, strengthening and dissolving remedies should be administered to render the blood stagnant in the lungs, blood vessels, and brain, more fluid, and to

promote the movement (of it) from the inner parts to the outer parts. For this purpose are useful 1-2 spoonfuls of cinnamon or balm water, strong and spiced meat broth, or also an herb tea of garden sage, balm, camomile, etc.

An asphyxiated person must be cut down, put to bed, and have a vein opened, and, if possible, one in the neck; then one must blow air into his windpipe, start rubbing, and finally employ all of the various stimulating remedies.

It behooves one to bring soon into fresh air those asphyxiated by coal gas, fermenting wine (or cider), open up a vein of the neck or arm, blow in air,* rub and shake them, and administer to them as soon as possible the volatile spirits of ammonia mixed with much water, or honey mixed with vinegar (2 parts honey and 1 part vinegar).

Warnings against the Extant and Superstitious Prejudices On the Matter of Those Who Rendered themselves Lifeless by Violent Measures (namely, Suicides)

Since many examples have already proven how prompt first-aid has saved the lives of many poor, insane or melancholic persons who intended to kill themselves (suicides)* and, since, on the other hand, there have been many people who seeing such people in the act have held back and refrained from life saving measures, not because of less love for the unfortunate fellow man, but because of an ingrained superstitious and misfounded fear that it might be held to their discredit, or should be held against them should they render this charitable help, our gracious lords and higher sovereigns suggest to the effect that everyone cease entertaining such vain and superstitious prejudices and urge him or them to help such an unfortunate individual promptly and energetically as a Christian duty and act of mercy, and, to this end, that if they perform as is wished by the state, he or they will be rewarded suitably if it can be indubitably proven to the satisfaction of the board of health after a careful and searching investigation that they have saved the life of

* Presumably into the windpipe and not in the vein of the arm or neck.
* The circumlocution is translated in this fashion.

an unfortunate one and as soon as the board of health has brought it to the attention of the authorities.

As for the rest, our distinguished and gracious lords and sovereigns have unanimously decided that, should failure attend an attempted resuscitation of those who in a violent manner have, as the result of insanity or melancholia, killed themselves, their bodies should be brought to the local "Theatrum Anatomicum," for dissection if the place, where the tragedy occurred is not more distant from this city than one hour.

Act of Saturday, April the 26th, 1766
Chancery Office of the City of Zürich

IVAR SANDSTRÖM

UNIV. OF MICH.

AN ENGLISH TRANSLATION OF SANDSTRÖM'S *GLANDULÆ PARATHYREOIDEÆ* *

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With biographical notes by Professor J. August Hammar, Upsala

INTRODUCTION

All workers in the field of parathyroid physiology and calcium metabolism have recognized Ivar Sandström of Upsala as the discoverer of the parathyroid glands, yet few can have read his original account since it has never been translated; and of the man himself little is known outside of Sweden. The announcement of the discovery of the parathyroids appeared under the title "Om en ny körtel hos menniskan och åtskilliga däggdjur" in volume 15 of the *Upsala Läkareförenings Förhandlingar* for 1879-80. Files of this journal are to be found in many of the larger medical libraries in America (i. e., Welch Library at Johns Hopkins, College of Physicians at Philadelphia, Boston Medical Library, John Crerar Library in Chicago, New York Academy, etc.). In the Army Medical Library the paper is also listed as a reprint of 31 pages with 6 plates (actually only 3, since the folding plates are listed IV, V and VI in the journal), published by E. Berling of Upsala in 1880. We have been unable to trace another copy of the reprint in America; however, references to the paper all too often cite, not the original, but usually one of the two short German abstracts which also appeared in 1880 (*Schmidt's Jahrb. d. ges. Med.*, 1880, **187**, 114-118, and *Jahresber. u. d. Fortschr. d. Anat. u. Physiol.*, 1880, **9**, 224-226).

Through Dr. Erik Waller of Lidköping a copy of the paper was obtained in its original form with the plates excerpted from volume 15 of the journal, and with it he also sent a short note on Sandström's life written in January 1936 especially for us by Dr. Johan August Hammar, Professor emeritus of Anatomy, University of

* Edited by Charlotte H. Peters and J. F. Fulton, Laboratory of Physiology, Yale University School of Medicine.

Upsala. Dr. Hammar had also written in 1908 a historical review on the parathyroid ("'Glandula parathyreoidea (Sandströmi)' En historisk öfverblick," *Hygiea*, 1908, (Festband), 16-24). This and an autograph letter now in Dr. Waller's possession from Sandström to his family, describing a further presentation of his work at an international gathering in Sweden are the main sources of information concerning the man.

Apparently this significant contribution has never been translated in its entirety into any language; it has, therefore, seemed worth while to undertake this, and we have been fortunate enough to enlist the services of Dr. Carl M. Seipel of the Eastmaninstitutet of Stockholm who has spent two years in the Yale School of Medicine. He has abstracted Professor Hammar's historical review of 1908, for which we have completed the references, and fully translated his notes of 1936 on Sandström, Sandström's letter to his family and, finally, the thirty pages of the parathyroid paper itself.

There is nothing to add to Professor Hammar's account of his life and work and we are merely availing ourselves of this opportunity to express to the three Swedish contributors, Dr. Waller, Professor Hammar and Dr. Seipel, deep appreciation not only on our own behalf, but, we are sure, of the entire English-speaking medical public for their interest and effort in thus making available this invaluable material regarding Sandström, as well as making possible this English version of his celebrated paper. Our thanks are also due to Dr. B. G. Anderson of the Department of Surgery, Dr. L. S. Stone, and Dr. W. H. Newton of the Department of Anatomy at Yale for their cooperation in the English text.

C. H. P.
J. F. F.

IVAR V. SANDSTRÖM[1]
1852-1889

By Prof. A. Hammar

Ivar Sandström was born March 22nd, 1852 in Stockholm. His father was Secretary of Agriculture, a brother was a prominent Latin linguist, and a sister was a pioneer in the field of school teaching. Sandström matriculated at the University of Upsala in the autumn of 1871, and the following year he passed the examination which permitted him to register in the medical faculty. Here he served as amanuensis in the Department of Anatomy during the year 1875/76. He took his preclinical degree (Med. Kand.) in 1878 and received an appointment as 'prosektor' in anatomy during 1879/80. In the autumn of 1881 he was appointed to the position of teacher in histology, which was vacant at that time. With short interruptions for his own studies he held this position until 1886. The following year he finished his studies for the medical degree and obtained his diploma as a physician.

However, even before this time a mental disorder hereditary on his mother's side, had necessitated a sojourn in a hospital for mental diseases. Although this stay was of short duration, his disorder was sufficient to diminish his scientific activity in succeeding years and finally brought his academic career to an end, causing his death in 1889.

Because of this circumstance his publication in 1880, "On a new gland in man and several mammals,"[2] was, with the exception of some minor communications, his only contribution to medical literature, a contribution which, however, will secure him a prominent position in this science.

The discovery of the new gland was made in 1877 while Sandström was still a medical student. It was originally made in a dog by macroscopical dissection. A superficial microscopic examination showed that it was a new organ of quite different structure from

[1] Translated by Dr. Carl Seipel.

[2] *Upsala Läkareförenings Förhandlinger*, 1880, 15, 441-471.

the underlying thyroid gland. Unfortunately time and material did not permit the immediate completion of the investigation, so that this could not be made until the winter of 1879-80. The existence of the gland in different species—other than dog (cat, ox, horse, rabbit and man) was established. In all these species the gland was constantly present. The main interest of the discoverer was focussed upon the conditions in man; he examined 50 individuals and found in most of them two glands on each side, but otherwise varying conditions.

Since Sandström's microscopical examinations were made with great accuracy, it was long before anything was added to his observations, a fact which has been pointed out by subsequent workers in this field. Welsh says in 1898:[3] "I cannot too strongly emphasise the admirable precision and accuracy which characterise this earliest record of these glands in man." And in the same way Thompson states in 1906:[4] "This paper of Sandström is so thorough that little has been added to our knowledge since their discovery and it is so complete as to leave no doubt, that he well deserved all credit for the discovery of these organs."

But the embryological technique of that time was not perfect enough to admit a thorough investigation of the complicated development of the gland. Referring to the analogy between the structural types of the new gland and the different developmental stages of the thyroid gland, Sandström assumed that he could distinguish the former as an embryological organ related to the latter, but arrested at different stages of development, more or less far from the type of mature thyroid gland. As we know it was reserved for the future to show not only the peculiar character of the gland, but also the vital importance which we now know that it possesses.

In this connection some episodes may be mentioned, which will show how conditions at that time differed in many respects from our own. When Sandström had made his first microscopic preparations of the new organ and was going to show them to his

[3] WELSH, D. A. Concerning the parathyroid glands: a critical anatomical and experimental study. I. A critical historical digest of the literature concerning the parathyroid glands. *J. Anat. Physiol.*, 1898, **32**, 292-307 (see p. 295).

[4] THOMPSON, R. L. A study of the parathyroid glandules in paralysis agitans. *J. Med. Research*, 1906, **15**, 399-423 (see p. 399).

teacher, Professor Clason, he happened to look in the professor's microscope, which was then focussed on a preparation of the hypophysis. Since the technique of those days could not sharply differentiate, the similarity between the parathyroid and the hypophysis was so great that Sandström astonishedly exclaimed: "Have you already seen the gland I was going to show you?"

How limited the views of the scientific journals at that time were is shown by the fact that a translation into German of Sandström's publication was made and sent to a German Archiv, but was returned with the message that it had to be considerably shortened before it could be published. However, the entirely factual description did not permit such an abbreviation, and therefore the careful report which Retzius made in the *Jahresbericht* of Hofmann-Schwalbe (1880, **9**, 224-226) was the only form in which the work was made accessible outside Sweden. But it was sufficient to make the investigation of Sandström appreciated when Gley in 1892 rediscovered and aroused interest in the new gland.

However, Sandström's life was short, and there is no doubt that the science of anatomy lost by his death a sagacious and highly original investigator. Physically he appeared a talented man. His tall, vigorous figure, the fine, well-shaped head with the penetrating eyes left no doubt of a personality of unusual capacity. And his gifts were highly fitted for the natural sciences, from which his teaching also received its character. In the discourses of the born teacher even relatively complicated things became transparently clear. It was Sandström who instituted the method of teaching in histology which ever since that time has been used and further elaborated in Upsala and which so far as I know is rather unique. The lectures were held at the microscope and over natural histological preparations, which at the same time are focussed in the microscope of each student, subjected to independent examination. And these slides were chosen in such a way, that when a number of them had been examined, a foundation was laid of personal observations upon which the total structural view of the tissue or organ in question could be summed up.

A Letter from Sandström to His Sister[8]

August 8, 1880.

". . . However, at my age one cannot stand doing nothing at the West-coast seaside for two weeks so it was rather with pleasure that I accepted an invitation from Stockholm to attend the meeting of the Natural Scientists (*Naturforskarmötet*) in order that I might do my part so that we Swedes should not succumb to our guests—which later on proved not to be the case at all. My idea of the whole performance was, besides, that it was a great Scandinavian bluff, at least I got that impression from the work within our section—or rather from the way the work was performed. One should, of course, at a personal meeting of so many men, who devote themselves to science, be inclined to expect less of a hurried reading of more or less unimportant 'products of genius' whose creators in any case would not forget to publish them, if they are of any value, than rather a friendly exchange of thoughts and a trustful communication of personal experiences and impressions. Nothing of the kind was seen. Within our section not a single voice was raised in discussion, and between the real meetings of the sections there were no opportunities for personal acquaintance, at the same time most of the men apparently did not show any tendency for making any. Everyone seemed to be there with the intention of showing what 'discoveries' *he* had made, and at the same time give the astonished world the opportunity to have a look at the fortunate discoverer. But for the discovery itself, for the *revealed truth*, the interest was little or none. I cannot help the sad and discouraging impression that most of our scientists are more apt to work for their own reputation than for the sake of science itself, and that the latter is regarded as a kind of modern album, wherein a lot of gentlemen compete to get their names written. As a real illustration thereto, I might give the utterance of a German celebrity, who happened to be present when I demonstrated my gland (it was Professor ———, a famous anatomist): 'There you have made a fine discovery and made yourself a name,' he said, but there was no

[8] This letter is now in the possession of Dr. Erik Waller of Lidköping, Sweden, and was translated by Dr. Carl Seipel.

question of getting any information about the discovery itself, because the famous 'scientist' was very eager to show that he had discovered a yellow coloring matter (Gentiana-gelb) that had the surprising property of giving tissues a yellow color. . . ."

GLANDULA PARATHYREOIDEA (SANDSTRÖMI)

A REVIEW OF THE HISTORY[6]

In the year 1880 Ivan Sandström published the discovery of a new gland in man and several mammals, which he had made three years earlier. The finding was originally made upon macroscopic preparation of the thyroid of a dog. Even other species were examined (cat, rabbit, ox and horse). Only one gland was usually found on each side in these animals and it was more or less connected with the thyroid gland. The discoverer was mainly interested in his findings in man. He examined about 50 bodies and in most cases he found two glands on each side but otherwise conditions which varied widely.

During his studies of the literature on the subject Sandström found a few short statements, one by Remak (1), and the other by Virchow (2), which seemed to indicate that these investigators independent of one another had seen the parathyroid gland, but otherwise it was entirely unknown in the older literature. A recent statement (Shattock, *British Medical Journal*, 1905, (pt. 4), 1694-1695) says that Owen (3) is said to have observed the parathyroid in rhinoceros in 1862.[7] Sandström's publication was in Swedish, and was only known through references in the literature of other countries. An independent observation by Baber (4) in 1881 was also published but likewise remained fairly unknown for a long time.[8]

[6] *Hygiea*. Festband 1908. Nr: 42, pp. 1-24. Translated in excerpt.

[7] "The thyroid gland consisted of two elongate, subtriangular lobes extending from the sides of the larynx to the fourth tracheal ring. . . . The structure of this body is more distinctly lobular than is usually seen; a small compact yellow glandular body was attached to the thyroid at the point where the veins emerge."

[8] "In the thyroid gland of the dog bodies of considerable size are frequently seen which differ entirely in structure from the rest of the gland. . . . They consist of a solid mass of more or less *cylindrical rows of cells* which are much convoluted and interlace in all directions. . . . In dogs aged three months and upwards

However during the following years, influenced by the studies on internal secretion, a strong interest grew up concerning the physiology of the thyroid gland. Work was done along several different lines for an explanation of the various results of thyroidectomy in different animals.

The importance of the parathyroid gland for the result of thyroidectomy was made clear by Gley (5) through a series of well planned experiments. The observations made by Gley drew immediate attention to the discovery of Sandström. Prenant (6) and others had already in 1893 and 1894 made observations upon the embryonic development of the parathyroid, but the correct interpretation of these findings was not possible until the anatomical conditions were further elaborated.

To what degree the gland is under nervous control is not yet entirely clear. Sacerdotti (7) observed nerves following the vessels into the gland. Andersson (8) found that not only did such nerves end in the walls of the blood-vessels, but they also showed thread- or bulb-like endings intraepithelially after several dicotomic divisions.

Concerning the pathological anatomy of the parathyroid gland Sandström had made some observations, one of amyloid degeneration and one of cystic degeneration of the gland. The stated assumption of Sandström that the parathyroid could be the center of pathological growth processes has also been shown to be true (9, 10, 11).

The knowledge that was thus acquired about the constant occurrence and independent origin of the parathyroid glands did not support the opinion, which for a time was the usual one, i. e., that they were rudimentary thyroid glands. Moussu (12) and Kohn (13) early supported the opinion of their independence of the thy-

I have usually observed these 'undeveloped portions' as distinct bodies, not continuous with the normal gland-tissue, but separated from it by layers of connective tissue and frequently lying in depressions on the surface of the gland. . . . In the thyroid gland of the dog, however, it is remarkable that although these bodies are of frequent occurrence, there is usually in dogs, aged three months and upwards no evidence to show that they are undergoing further development. It is an interesting question whether the undeveloped portions, which are distinct from the gland, may not under certain circumstances become developed into true gland tissues, and either give rise to the isolated lobes mentioned by various authors, or simply cause an increase in the size of the gland itself." (See pp. 600-602.)

roid gland. Likewise Maresch (14), Fusari (15), Aschoff (16), Peucker (17) and Pineles (18). However, experimental research gave the final justification for this opinion.

Vassali and Generali (19) made extirpations of both the "inner" and "outer" parathyroid glands. The animals died after a few days with paralytic and convulsive symptoms. With Donaggio, Vassali (20) showed in 1897 a peculiar degeneration of the crossed pyramidal tracts and the posterior columns of the spinal cord in the parathyroidectomized animals. Transplantation of the parathyroid prevents the characteristic symptoms in parathyroidectomized animals (21, 22, 23, 24, 25, 26). Investigations by Pineles (27) and Erdheim (28) demonstrated that tetany after struma operations occurred less often since the method used (intracapsular extirpation, wedge-formed resection) has brought about conservation of the parathyroid region (29).

In 1902 Jeandalize (30) suggested that certain spasmodic states in man (convulsions in children, tetany, epilepsy, eclampsia) perhaps had their origin in an insufficiency of the parathyroid, but at the same time he warned against an exaggerated generalization of this point of view. Regarding the tetany of pregnancy, if 1-1½ of the outer parathyroid gland in the rat was extirpated there was generally none or a rapidly disappearing tetany, but if pregnancy occurs, tetany will follow and this condition might be repeated in succeeding pregnancies in the animal (31).

Pepère (32) also believed that he had found microscopic signs indicating an increased activity of the parathyroid gland in pregnancy, occurring as an increase of the number of oxyphil cells and of the amount of colloid, changes which under similar conditions have been found in the anterior lobe of the hypophysis. The similarity of the clinical symptoms in the parathyroidectomized animals and those of eclampsia in women has been advocated by some investigators and questioned by others. Parathyroid medication has been suggested in eclampsia (33, 34). The offspring of parathyroidectomized animals is far more sensitive to parathyroidectomy than others (35). Mironesco (36) described complete atrophy of two of the outer parathyroid glands in a case of pellagra.

Of considerable interest are the attempts that have been made in

recent years to associate our present knowledge of the parathyroid gland with certain derangements in the muscular system. This idea was brought out by Lundborg (35) in 1904 when he tried to show, through coördination of known clinical and experimental facts that the parathyroid gland must be intimately associated with normal muscular and neuromuscular activity.

Pighini (37) obtained promising results by parathyroid medication in three cases of dementia praecox, which caused him to consider the possibility that the catatonic symptoms of this disease might be related to a changed or decreased parathyroid function. In a later investigation of the metabolism in the disease in question, the same investigator found in its chronic phase an increased Ca-excretion, which might be mentioned in relation to the later work of MacCallum and Voegtlin (38).

As a working hypothesis some American investigators (38, 39) were of the opinion that the parathyroid in some way controls the calcium metabolism of the body. On extirpation of the gland a condition of increased excitability occurs, similar to that which Loeb (39) and MacCallum (38) had earlier induced by precipitation of the Ca-salts within the organism. It is at the present time [1908] impossible to evaluate the idea which the two American investigators have given. If their results should be confirmed they will undoubtedly lead parathyroid research into new fields and we then stand before a new and promising period in the history of research concerning this gland.

Whatever this development may be, this history seems to me already to be of unusual interest. It shows an anatomical discovery which originally was looked upon more as a curiosity, but which after more than a quarter of a century promises to revolutionize entirely vast fields of practical medicine. It is an interesting example of what we may expect and hope from the rising research on the endocrine glands.

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ON A NEW GLAND IN MAN AND SEVERAL MAMMALS[1]

IVAR SANDSTRÖM

About three years ago [1877] I found on the thyroid gland of a dog a small organ, hardly as big as a hemp seed, which was enclosed in the same connective tissue capsule as the thyroid, but could be distinguished therefrom by a lighter color. A superficial examination revealed an organ of a totally different structure from that of the thyroid, and with a very rich vascularity. Therefore I thought it could possibly be a vascular gland like the *Gl. carotidea*. Even in the cat and the rabbit similar glands were found. However, time and material did not allow me to continue the investigations, and it was not until this winter [1880] that I have been able to take the problem up again. The existence of a hitherto unknown gland in animals that have so often been a subject of anatomical examination called for a thorough approach to the region around the thyroid gland even in man. Although the probability of finding something hitherto unrecognized seemed so small that it was exclusively with the purpose of completing the investigations rather than with the hope of finding something new that I began a careful examination of this region. So much the greater was my astonishment therefore when in the first individual examined I found on both sides at the inferior border of the thyroid gland an organ of the size of a small pea, which, judging from its exterior, did not appear to be a lymph gland, nor an accessory thyroid gland, and upon histological examination showed a rather peculiar structure. After several examinations not only was I convinced of the constancy of its appearance but I was also able to show that two such glands in most cases occur on each side. Since then my interest has been so predominantly centered on a deeper study of the structure and importance of these glands in man, that examinations of animals have been limited to dog, cat, rabbit, ox, and horse, and even there they have been rather scanty. However, I hope to complete a comparative study and description on some other occasion.

[1] A translation from the Swedish by Dr. Carl M. Seipel of Stockholm. From *Upsala Läkareförenings Förhandlingar*, 1879-80, 15, 441-471.

The glands under discussion show in man widely varying conditions both with regard to size, form and color—in short with reference to all their macroscopic characters. Among approximately fifty individuals which I have had the opportunity of examining, I have never completely failed to find these organs. In five cases I found only one gland on each side; in two cases I found one gland on one side, none on the other. It is to be observed, however, that in these seven cases the examination was done *in situ*, through a mid-section in the throat, and without removing the organs. Under such circumstances to state with certainty the existence or non-existence of organs like those in question might often be difficult even with the most careful method of preparation.

Concerning the position, they are always situated close to the thyroid gland, at the posterior surface of the lateral lobes, or close to their inferior borders. For the purpose of a closer determination of the position, the following facts must be remembered about the form and position of the thyroid gland. If we look at it in its natural position, we will find that its lateral lobes together with the isthmus form, to a certain extent, a horseshoe-shaped figure, the concavity of which is directed upward and at the same time somewhat backward, insofar as the isthmus is resting against the front of the trachea, and the upper parts of the lateral lobes against the posterior border of the thyroid cartilage. Accordingly the anterior border of the thyroid is distinctly inclined forward and downward. The posterior surfaces of the lateral lobes are, in their upper halves, vertical; the lower half of this surface is sharply inclined forward, forming together with the anterior surface, the inferior rounded border of the gland. On sagittal section of the lateral lobes of the gland the posterior surface therefore appears as an arch, the convexity of which is directed dorsally, providing the conjunction between the two surfaces has been gradual; otherwise it forms a more or less markedly bent line. Laterally the posterior surface joins the somewhat sideward-looking anterior surface with the formation of a more or less sharp outer border line, which in its turn passes downward over into the inferior border of the gland. Medially the posterior surface joins the inside of the lateral lobe which is resting against the trachea and the larynx. The inner posterior border-line

LEGENDS

Plate IV. Figs. 1-5 are in natural size. Fig. 6 is enlarged twice.

Gl. thyr. — thyroid gland.
Gl. pth. — parathyroid gland.
a. car. — carotid artery.
oes. — oesophagus.

Fig. 1. From homo, posterior view. Oesophagus and pharynx are removed. m. constr. ph. inf. — cut laryngeal origin of the inferior constrictor of the pharynx. The two superior ones of the four parathyroid glands are connected to the thyroid through a minor fat layer.

Fig. 2. From a large dog, right side view.

Fig. 3. From ox, right side view. isth. — isthmus of the thyroid gland.

Fig. 4. From cat, left side view.

Fig. 5. From horse, left side view.

Fig. 6. From rabbit, left side view, enlarged $\times 2$.

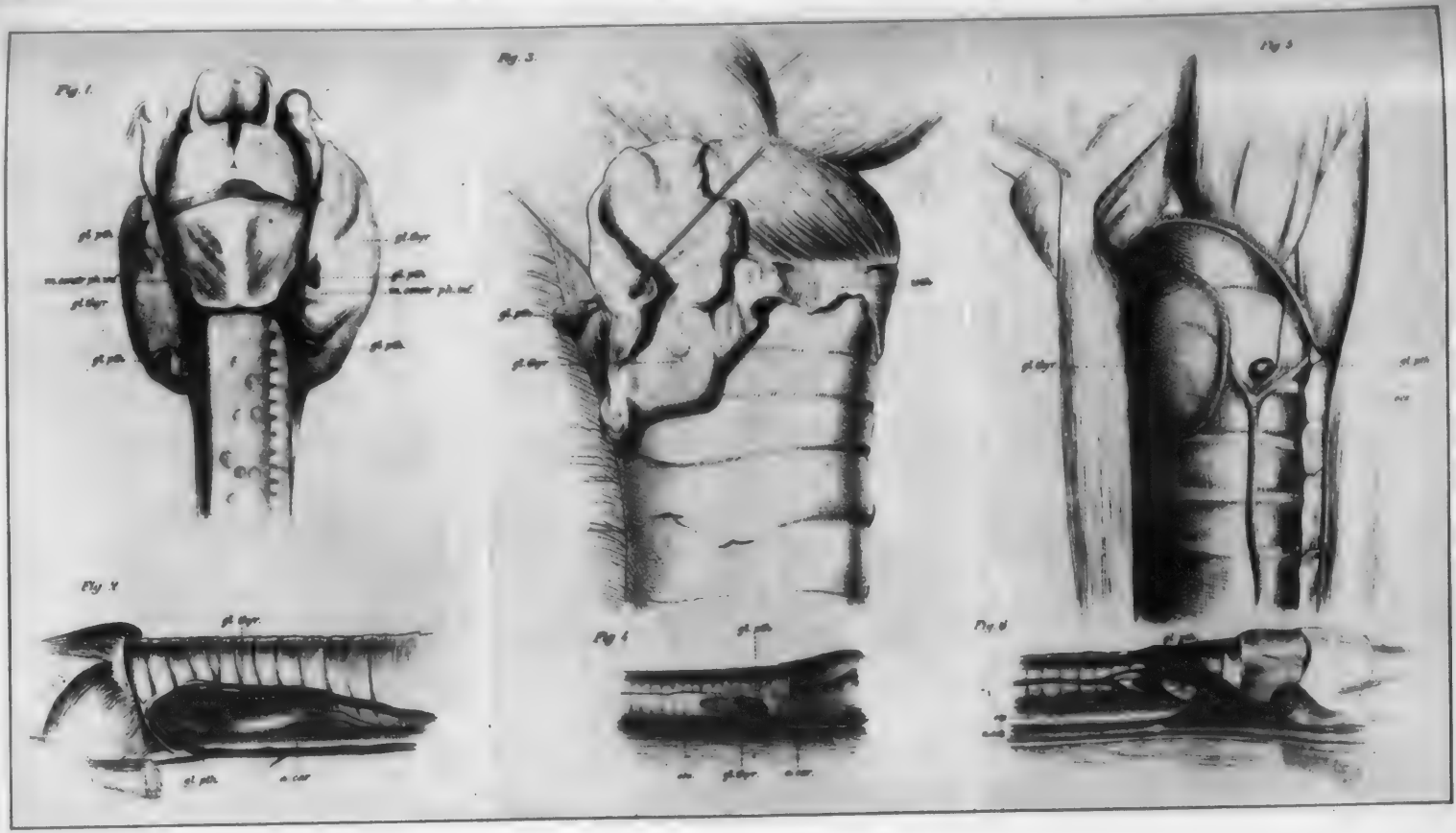

PLATE IV. Sandström translation.

between these two surfaces therefore runs along the side wall of the larynx and the trachea; in its upper part and corresponding to the height of the upper half of the posterior surface it runs vertically, further down it bends forward following the direction of the inferior half of the surface in question. It is at the inner posterior border of the lateral lobe, always at the place where this edge ceases to be vertical and takes the direction forward and downward, that the inferior thyroid artery reaches the thyroid gland. It is also along this border that the glands in question are mostly situated. Frequently they are both found along the inferior thyroid artery; one of them immediately above and the other one just below the place where the artery enters the gland. Often they are also placed more laterally, close to the outer border of the posterior surface. Or one of them lies farther down, at the inferior border of the thyroid gland, sometimes a short distance below this border, on the trachea, or in the fat which surrounds the trachea. Generally it seems to be the inferior one of the two glands which is most variable in its position. In a few cases I have found this latter gland on the inferior part of the anterior surface of the lateral lobe. The superior gland generally is placed at the posterior inner border of the lateral lobe and is very often found lying on the origin of the *Musc. cricopharyngeus*. The glands are generally united with the thyroid by means of soft connective tissue, so that they are often movable against its capsule. Sometimes the connection is more indirect; one will find the glands lying in small well-defined fat lobules which are connected by means of a thin stalk with the thyroid gland. In such a case I have found a fat lobule of this kind also enclosing an accessory thyroid gland. In another case I have seen the connection with the thyroid being maintained by a separate portion of thyroid substance, and one often finds the glands located on a protruding part of the thyroid. The position as well as the relation to the thyroid gland thus show a number of variations and any symmetry with regard to location does not seem to exist between the glands of the right and left side.

Equally variable are the size and form. Sometimes the glands are only 3 mm. in their largest dimension, in other cases they reach a length up to 15 mm. The most usual size is apparently about 6

mm. In children one will not infrequently find glands that also reach this size, but generally they are smaller even if relatively large in relation to the size of the thyroid of the same individual. Their form is generally more or less compressed and plate-like, sometimes so much so that the thickness is hardly 2 mm., while the width and length are of the usual dimensions or even larger. The superior gland has not infrequently a rather elongated form in which case the long axis of the gland lies parallel to the posterior inner border of the thyroid.

The color is also somewhat variable; usually reddish-brown, sometimes of the same color as fresh human liver, but in most cases having a marked tint of yellow, like that of many fish livers. Sometimes this latter color is so predominant that the gland can be distinguished from the surrounding fat only by very careful examination. However, even in this case it is recognizable from the fat by a darker color, somewhat of a reddish-yellow like that of the cortex of the suprarenal glands.

To each one of the glands there are one or more smaller arterial branches from the inferior thyroid artery; the veins either run into the larger vein stems which branch over the surface of the thyroid gland, or also directly into the *venae thyr. inf. laterales.*

From the above description of the macroscopic appearance of the glands one can see that whatever variations they show in color, form, and position, yet they are in most cases possible to recognize from the surrounding tissues with the naked eye. When in search of them it seems most convenient to remove the thyroid together with the oesophagus and the trachea and make the examination from the posterior surface, leaving the oesophagus intact in relation to the trachea. As already mentioned it is chiefly at the posterior inner surface of the thyroid gland that they are situated. In well-nourished individuals there is a small fat deposition in this region, filling the channel-shaped space between the oesophagus and the aforementioned border of the thyroid, reaching upward to the origin of the *Musc. constrictor pharyngis inferior.* This fat must not be removed without first being carefully examined. Not infrequently one finds in this fat-layer well-defined lobules, which are sometimes rounded, sometimes flatter, now and again more elongated, and

which are usually connected with the capsule of the thyroid through a thin peduncle containing blood vessels. Such lobules usually contain the glands under consideration, sometimes lying just under the outer layer of connective tissue, so that it is only necessary to free the fat lobule from the surrounding structures in order to find the gland, which is usually easily distinguishable from the fat by its darker color. In other cases it is embedded in the midst of the fat, and if it is at the same time of a smaller size, it might easily be overlooked. In such cases one should not forget to examine the transparency of the fat lobule against a strong light. The presence of the gland is then usually recognized through a greater opacity, relatively well-defined, in the interior of the fat lobule. In the cases where the fat lobule has a more elongated form one usually finds the gland, which is likewise elongated in form, either in the center of the fat lobule, separating the latter into two halves, but sometimes closer to one of its ends. It is, however, by all means not in all cases that the gland is thus surrounded by fat, for very often it is situated under the fat directly on the capsule of the thyroid gland and relatively movable against the latter. It is usually in these cases that one will find glands of extremely flat form, so that they are hardly recognizable as protruding from the surface of the thyroid. If they are then at the same time of a darker color it requires rather good observation not to overlook them in the preparation. A difference in color, however slight it may be, gives the clue to the examiner. The difficulty in detecting these glands lies more in possible confusion with other gland-like organs, which are rather numerous in this region. Namely, the usual lymph glands, which are sometimes present in rather large numbers, and the so-called *Gl. thyroideae accessoriae*, which however, are less frequent in occurrence. From both of these kinds of structures they are in most cases relatively easy to distinguish, although at times the difficulties may be considerable. Therefore it seems not to be out of place to point out some of the main characteristics through which the glands in question are distinguishable with the naked eye from the organs mentioned above, even if some repetition of what has already been said may be necessary. On deciding whether the gland before us is a lymph gland or one of the glands we are searching

for, it is the color, transparency, consistency and texture which give the necessary guidance. Concerning the color what is mentioned above seems to be about sufficient to show what good guidance one is able to get from it. Sometimes, and especially in case of heavy congestion of blood in the organs of the cervical region, the differences in this respect might be more or less imperceptible—in such a case one gland as well as the other has the darker color. But even so, one can here find a good clue in the pigmentation of the lymph glands. As I have observed it is a rather common and, in older persons, a constant condition that the lymph glands, which lie close to the inferior border of the thyroid gland, show a decided, if also scanty pigmentation, of the same kind as that in the bronchial lymph glands. In cases of less venous congestion recognition is fairly easy; the interfollicular vein plexuses of the lymph glands are then quite clear and show up as a system of rather well-defined red rings surrounding each follicle. In the other glands one finds nothing of this kind except for a more or less clear dendrite-like picture of veins on the surface. Furthermore the lymph glands, unless they have undergone pathologic changes, are characterized by a certain transparency. This is totally lacking in the other organs, which on the contrary show a certain dull, greasy appearance on transection. This condition might, however, even be found in lymph glands undergoing pathologic changes, although their consistency is in such cases far more solid.

The accessory thyroid glands which occur occasionally may also lead to mistakes. Even if their color, which is highly changeable does not give any sure signs for their detection, it is usually possible even with the naked eye to see part of their finer structure, especially if they, as is often the case, contain at least some enlarged alveoli. In such cases their surface has a more or less knotty appearance and the cut surface often shows a lot of fine holes, which makes it look porous. It is to be remarked that these accessory thyroid glands sometimes lie close to the glands in question and occasionally they are both enclosed within the same fat lobule. In these cases when one has the opportunity of direct observation there should be no difficulty in distinguishing the two glands. Even the fat may lead to mistakes; not so much the usual light yellow fat as the reddish

yellow or so-called serous fat, which appears in thin, undernourished individuals. In such cases each suspicious fat lobule, which is distinguished through a somewhat darker color and less transparency, should be carefully examined.

Before I take up the description of the microscopic structure of the glands it seems advisable to mention a few words about the methods which have been used for their preparation in microscopic sectioning. That only the freshest possible material can be used need hardly be said. Glands which have been taken out later than 24 hours after death have generally not been used. At least during the cold months of the year they do not undergo any remarkable changes in their finer structure before this time. I have had opportunity to observe through comparison with absolutely fresh glands collected 3 to 6 hours after death. For fixing of the glandular substance, which is rather loose in a fresh condition, several methods have been used. The best results I have had were obtained by treatment for several weeks with Müller's solution followed by strong alcohol for 24–48 hours. The consistency is then rather favorable for making thin sections. If one compares the structure of a gland fixed in this way with one that has been fixed in osmic acid one finds that the different structural elements of the tissue have been rather well preserved in their original condition. The latter fixing fluid has also been used in a strength of ¼-2 per cent and has then as always given good results. However, as this fluid has the disadvantage of not penetrating deeply, one has to divide the gland into several smaller pieces and if one wants to stain the sections with carmine one has to prepare them immediately after the treatment with osmic acid. This circumstance together with the necessity of dividing the gland before fixing, which makes it impossible to get continuous sections through the whole thickness of the gland, has made me use the osmic acid mainly for the study of the form of the cells and as a reagent on the fat drops in the cells. For the demonstration of the structural arrangement of the glandular substance one may use osmic acid solutions of ⅛-¼ per cent strength for about 72 hours and follow by treatment with strong alcohol (90 per cent) for 24–48 hours. However, this method often causes considerable shrinkage of the cells and thereby sometimes gives the

most peculiar pictures. The capillary network by this method comes out very clearly, likewise the membranes which enclose the glandular substance. For the isolation of the cells I have been using weak solutions of osmic acid (0.1 per cent) and 10 per cent NaCl solutions.

On the transection of a gland that has been fixed in one way or another one might see the lobulation of the glandular substance providing this exists; for not infrequently one will find no more lobulation than in the lymph glands. Usually it is not well-defined, and in most cases not possible to see with the naked eye. The lobes which generally are not separated in their whole length are enclosed within a common sheath of connective tissue which is continuous with the more scanty interlobular connective tissue.

The glands show under low magnification a granulated substance, wherein under higher magnification one can see the cells lying close to each other. If a very thin part of a slice from a preparation fixed in osmic acid or in Müller's solution is chosen for examination one will see the cells containing a rounded, homogeneous nucleus of about the size of a red blood corpuscle and a small amount of a finely granulated protoplasm. In such a preparation, however, one generally does not see any marked borders between the cells, but the well distinguished nuclei of the cells lie, as it were, embedded in a continuous mass of protoplasm (Plate V, fig. 7). If the preparation is from a gland that is not quite fresh, or if it has been fixed in chromic acid, one sometimes can see a very fine network of thin threads, sometimes more like ribbons or laminae, which are somewhat broader at the crossing points, and in the meshes of which the cells are enclosed. So far this intercellular net seems to correspond to similar structures in the lymphoid organs; but the conformity does not seem to reach further than to this similarity of arrangement. The threads and laminae of the former structures are namely, incomparably finer, less refractory, more uneven and indistinct in their contours; and in their finer structure they do not show the uniform appearance which the reticulum of the lymphoid organs shows, but seem to contain an exceedingly fine granulated substance. I therefore consider this structure as a ceratoid substance uniting the cells, which has been brought to light either by a shrinkage of

Plate V.

Fig. 1. Transection through the parathyroid and part of the thyroid gland in dog. Acid potassium bichromate 2 per cent solution, eugenol, Canada balsam. Vessels injected. Drawn at Hartnack, object 4, ocular 3, tube not drawn out.

Fig. 2. Section of the parathyroid gland from ox. Müller's solution. Carmin, glycerin. Parenchyma in scattered, irregular groups with rich vascular supply and surrounded by connective tissue. Hartnack obj. 4, oc. 3.

Fig. 3. Section of the parathyroid gland from man. Blood vessels injected. Acid potassium bichromate, 2 per cent solution, carmin, eugenol, Canada balsam. Drawn at Hartnack obj. 4, oc. 3, tube not drawn out.

Fig. 4. Section of the parathyroid gland from man. Fixed in Müller's solution and 90 per cent alcohol. The parenchyma here appears as a continuous cell mass. Numerous capillaries filled with red blood cells are seen in cross section as well as in longitudinal section.

Fig. 5. Section of the parathyroid gland from man. Fixed in weak chromic acid. Carmin, glycerin. Glandular substance in follicular arrangement. Between the follicles are seen a large number of vessels filled with red blood corpuscles (b). At (a) the limiting membrane of the follicle is seen, partly torn off from the glandular cells. Drawn at Hartnack obj. 7, oc. 3, tube drawn out.

Fig. 6. Isolated cells of the parathyroid gland from man. 0.1 per cent osmic acid. Carmin stain, potassium acetate. (a) shows a cell with clear nucleus and with a very thin layer of protoplasm around it. In the other cells the protoplasm is more abundant, granulated, and contains fat drops that are stained black from osmic acid. The cell (d) shows a protoplasm with protrusions. In (f) and (g) there appears besides the black fat droplets an almost unstained drop of colloid. In (f) it is fairly small; in (g) it is larger than the nucleus. Drawn at Hartnack immersion obj. 10, oc. 3, tube not drawn out.

Fig. 7. Thin section of a parathyroid gland from man. Fixation in osmic acid, carmin stain, potassium acetate. No borders between cells. The cell nuclei (a) are embedded in a fine-granulated protoplasm. Rich intracellular fat content: both larger (b) and smaller fat drops (c) arranged in groups. Drawn at Hartnack immersion obj. 10, oc. 3, tube not drawn out.

Fig. 8. Section of a parathyroid gland from man. Fixed in Müller's solution and in 90 per cent alcohol. Carmin stain. Parenchyma arranged in follicles. The follicles lying at the periphery of the gland (a) are made up of more protoplasma rich cells. (b) is the torn off membranae propriae. (c) is a transection of a vessel. Drawn at Hartnack obj. 7, oc. 3, tube drawn out.

Fig. 9. Section of the parathyroid gland from man. Fixed in osmic acid ¼ per cent. The parenchyma shows an extremely reticular arrangement. The cell nuclei and the border lines between the cells are not seen, but the fat droplets in the protoplasm are clearly demonstrated. In the interstitial tissue numerous empty blood vessels are seen. Drawn at Hartnack obj. 6, oc. 3, tube drawn out.

PLATE V. Sandström translation.

the whole cell protoplasm through the fixing fluid, or by a partial disintegration on account of incipient decomposition. In both cases the volume of the cells is decreased so that they are not able to fill the meshes of the network, the threads of which, therefore, are easier to recognize. That no such network, or on the whole no clear cell borders, are to be seen in preparations from fresh glands, fixed in a very reliable solution, must have its explanation in the fine granulation of the substance that forms the network and its small refractive power.

The protoplasm is, as already mentioned, usually rather scanty, often it consists only of a quite thin zone around the nucleus (Plate V, fig. 6a). Sometimes it is more abundant and lies mainly on one side of the nucleus, and at other times forms rather long projections which stretch in between the neighboring cells (Plate V, fig. 6d). The cells very often contain fat drops (Plate V, fig. 6a, 7), sometimes in such quantity that they look like the cells undergoing fatty degeneration which are so frequently found in pathological conditions. The size of the drops, however, varies widely; the largest of them are generally about the same size as the cell nucleus, sometimes slightly smaller. The smaller fat drops lie here and there in clusters of about the same size as a larger drop (Plate V, fig. 7c), wherefore it is probable that the latter have their origin in the confluence of a group of smaller drops. For the examination of the fat content of the cells the osmic acid here as always is very suitable, because of its capacity of staining all fat intensely black. This ability is advantageous here since one will sometimes find in the isolated cells other homogeneous particles besides the fat which are highly refractive and which do not take stain from the osmic acid (Plate V, fig. 6f, g). They do not get cloudy nor are they dissolved by acids, by volatile oils or by ether. This seems to prove that they do not consist of fat or mucous substance, but seem to have all the characteristics of a colloid. To get clear evidence of this, however, seems to be hard, since we still do not have any positive reaction for this substance. Besides the protoplasm-poor cells described above, there is often another kind, with a far more abundant, richly granulated protoplasm. Such cells are assembled in smaller or larger groups, generally at the surface of the gland, sometimes in its in-

terior, and are now and then more clearly delimited from each other. In unstained preparations one generally sees nothing of the nucleus, it is entirely covered by finely granulated, strongly refractive protoplasm (Plate V, fig. 8a).

The glandular substance consisting of the cells just described shows in its coarser arrangement many variations, not only in different individuals, but also in different sections from the same gland.

Often it seems to be one solid mass of cells, the continuity of which is interrupted only here and there by vessels piercing the gland, followed by some connective tissue. The rather numerous capillaries which form a network in the gland, lack a coating of connective tissue, so that their walls lie in direct contact with the cells (Plate V, fig. 5).

In other cases there is more abundant interstitial connective tissue, which, following the branches of the vessels, gives a more or less net-like arrangement to the glandular substance (Plate V, fig. 9). The histological elements which make up the glands, namely, on the one hand the glandular cells, on the other, the vessels and the connective tissue that coats them, may be said in this case to form two systems of network, one of which is enclosed in the meshes of the other. The relative width of the meshes of the two nets vary, but usually those of the interstitial network are larger and thus the strands of the parenchyma are thicker than the connective tissue bundles in between them. Sometimes the nets may be about equal, as Plate V, fig. 9 shows. Not infrequently the meshes are more elongated in one direction or another so that the cells lie in long strands, which are here and there united by shorter side connections. If these latter parts are overlooked one might easily, from a smaller field of the preparation, get the impression that the cells are arranged in altogether separate cords which I, on closer examination, never found to be the case (Plate VI, fig. 1).

Finally the glandular substance may be arranged in larger or smaller cell groups, totally separated from one another (Plate V, fig. 5, 8). Such formations are usually found close to the surface of the gland and the cells lie in one single layer along a smaller or larger part of the periphery of the section, or they are collected in

Plate VI.

Fig. 1. Section of a parathyroid gland from man. Weak chromic acid solution. The parenchyma in a reticular arrangement with drawn out meshes. In the part of the section that is drawn there are no transverse connections between the longitudinal cell cords. In the interstitial connective tissue there is a fat cell here and there (d) and a very clear capillary net (a) which is also continued within the cell cords, where some cross sections of the capillaries are seen (b). At (c) a membrane is seen that has lost its connection with the cell strand. Drawn at Hartnack obj. 7, oc. 3, tube drawn out.

Fig. 2. Section of a parathyroid gland from man. Fixed in weak chromic acid. The parenchyma shows a fairly irregular arrangement with numerous fat cells interspersed (a). (b) = cross section of blood vessel. Drawn at Hartnack obj. 5, oc. 3, tube drawn out.

Fig. 3. Section of a parathyroid gland from man. Fixed in weak chromic acid. Hematoxylin stain. Canada balsam. Follicular arrangement of the parenchyma. Formation of alveoli is clear. The rounded, dark bodies are colloid drops intensely stained by hematoxylin. (d) is an empty alveolus with almost cylindrical cells having the nuclei at the peripheral, basal part. (a) shows three alveoli almost completely filled with colloid, (c) is a smaller drop of colloid not completely filling the alveolus, (b) is a smaller colloid drop. There are some follicles without the formation of alveoli. (e) is an empty fat-cell. (f) are transections of blood vessels, smaller and larger. Drawn at Hartnack obj. 7, oc. 3, tube drawn out.

Fig. 4. Section of a parathyroid gland from man. Weak chromic acid. The parenchyma partly in follicles, partly in larger, continuous cord- and bulb-like clusters. Formation of alveoli in different stages. (d) is an alveolus that is completely filled with colloid, the walls being formed by only one layer of cells. (a) is a cell-cord that contains alveoli and colloid in two different places. (b) is a larger vein filled with blood; (c) capillaries. Drawn at Hartnack obj. 6, oc. 3, tube not drawn out.

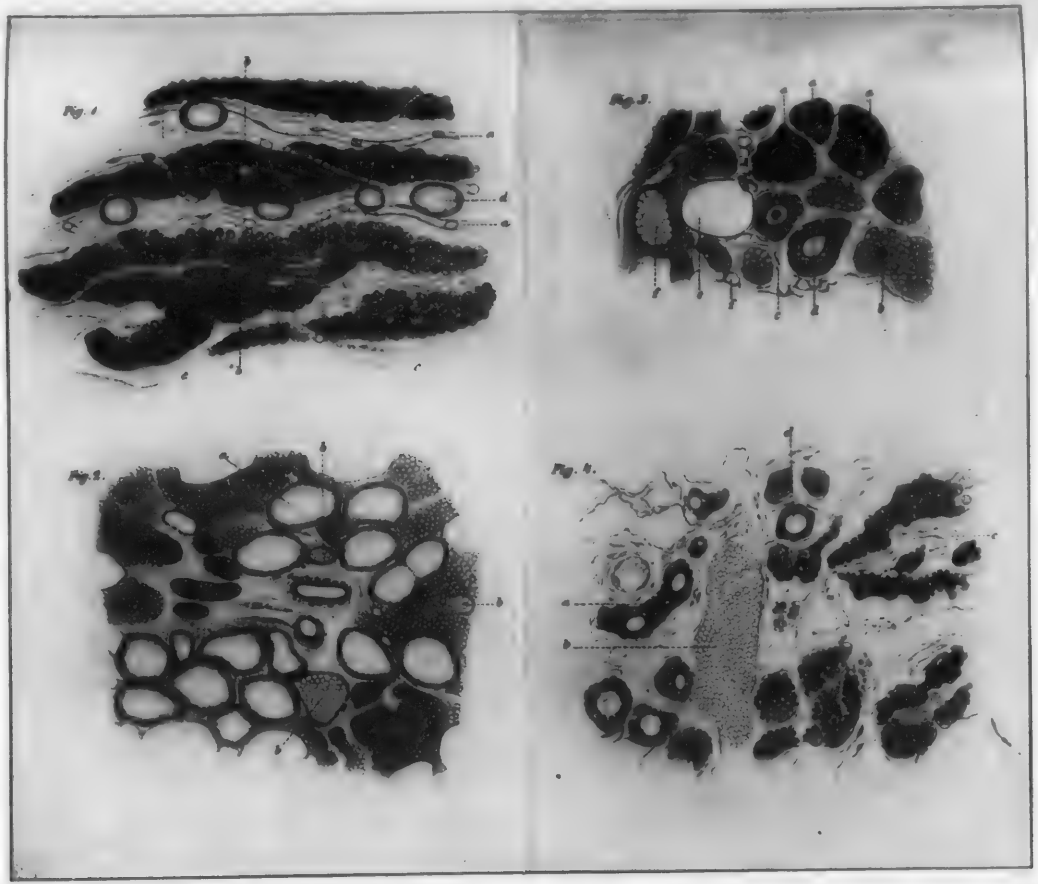

PLATE VI. Sandström translation.

larger groups which reach toward the center of the gland or fill out some of the more protruding parts of its periphery. As already mentioned the parenchyma of one and the same gland may be arranged in all these different ways, or in other words be more or less dispersed in different parts of the gland. I want especially to point out that the existence of the cell clusters mentioned above, or as I from here on want to call them, the follicles, is by no means limited to the parts of the gland where the cell arrangement is reticular, but appears equally often on the surface of a gland where the parenchyma is more continuous. Even in the cases where follicles do not occur in a parenchyma of this more solid arrangement, one may yet see pictures which possibly indicate an incipient or arrested follicle formation at the surface of the gland or close to its border. This border is often uneven or indentated because there are grooves penetrating more or less deeply into the gland which are small at their outer openings but often enlarged at the bottom and there harbour a vessel, usually a vein. When now approximately the same picture appears in a series of successive sections of the same gland, one finds that the otherwise continuous cell mass is at its periphery divided into a number of larger or smaller segments, through a system of thin slits, filled with connective tissue. These segments are usually connected internally with the solid parchenchyma, sometimes along a broad base, sometimes only by means of a smaller cell bridge.

In the whole preceding description of the structure of the gland, the cell clusters, the cell strands, or the continuous cell mass have been mentioned as entirely solid structures. This is far from being always the case. Here and there in a preparation one will find quite often larger or smaller cavities, lined by glandular cells, which in most cases enclose a rather transparent, entirely homogeneous, and strongly light refracting body, the form of which is usually rounded, sometimes elliptical (Plate VI, fig. 3, 4). Its appearance and reactions are entirely in agreement with the previously mentioned rounded bodies which one sometimes finds in the protoplasm of isolated gland cells and which on account of the aforementioned facts were considered to consist of colloid. The size of these cavities is very variable, sometimes little larger than the glandular cell,

in other cases they reach the average size of a thyroid alveolus. As already mentioned, these cavities are usually filled with a colloid drop which on account of its lustre is recognized without difficulty and therefore it is usually easy to observe them. The difficulties, however, become greater as the cavities and the colloid drops get smaller, especially in cells with a rich intracellular fat formation. The osmic acid even here shows what is fat and not fat, but by the black staining, especially when it is heavy, the preparation loses in transparency and clearness. I have therefore applied for the study of these alveoli a method which certainly is not always successful, but which often gives very clear pictures; namely, the hematoxylin stain after fixation in chromic acid. The stained sections are examined in eugenol or in Canada-balsam. In the preparation treated this way all the fat is removed, the cells and their nuclei have taken a faint grayish-blue color, the colloid, on the contrary, is dark blue or black-brown according to the intensity of the staining. In such a preparation all the colloid drops are fully visible, although they are often not larger than a cell nucleus. To decide how these, the smallest colloid drops, lie in relation to the cells, if they are situated beside or within them, is often hard because of the lack of clearness of the cell borders and the small size of the cells. That they may lie within the cell has already been mentioned. The larger colloid drops and the alveoli which enclose them are easy to see without any preparation. Sometimes one finds within one and the same preparation both colloid drops entirely filling the lumen of the alveoli, and drops that are considerably smaller than the lumen, in which case one has to assume that the alveolus besides colloid has also had some albumen containing fluid, which has been lost during the preparation. That the apparent space between the colloid drop and the alveolar wall has not been caused by the shrinkage of the colloid through the preparation fluid seems to be clear, as one will see the colloid drops in other alveoli of the same preparation entirely filling this space. The walls of the alveoli consist of the often unchanged glandular cells in one or two layers according to the size of the cell clusters and the alveoli. If they are rather large their walls generally consist of a single layer of cells (Plate VI, fig. 4d). Sometimes one finds the cells nearest to the alveolus to be richer in protoplasm

and differing somewhat in their form from the general type of cells in the gland. They are more cylindrical and somewhat wider at the outer end, where the nucleus has its place (Plate VI, fig. 3d). Even the borders between the single cells are clearer. Often one will find two or more such alveoli of differing size in each cell cluster, and in a cell cord or a long follicle one often sees several alveoli lying in a row one after another. The formation of alveoli, however, is a process which occurs more rarely and which never reaches far enough to involve all the gland cells, but generally occurs only in particular places of the glandular parenchyma. Even the above mentioned larger cells that are richer in protoplasm and more light-refracting and usually located close to the surface of the gland take part in this formation of alveoli.

After this description of the glandular parenchyma it remains to mention a few words about the interstitial tissue. The glands are surrounded generally by a rather thin capsule of connective tissue which shows the usual structure for a connective tissue of this kind. From this capsule there penetrate into the interior of the gland strands of connective tissue, varying in size and number according to the varying arrangement of the parenchyma. In their structure they are in no way different from the connective tissue of other glands. Against the glandular substance this interstitial tissue is limited by thin membranes, which are to be looked upon as an analogy to the *Membranae propriae* of other glands (see Plate V, fig. 5a, Plate VI, fig. 1c). Those membranes often show up rather well in preparations which have been fixed in weak chromic acid solutions, a fact that undoubtedly depends upon the shrinkage of the cells resulting from this fixing fluid, whereby they separate from the membrane that is otherwise lying close to their walls.

Such limiting membranes I have found both at the side of the parenchyma lying against the capsule and along the separate strands in the reticular arrangement of the glandular substance; now and then I have also found them around the follicles. They always appear to be homogeneous and structureless, but sometimes they show a nucleus. In the interstitial tissue there are often fat cells in a considerable number, and they may sometimes be so numerous that the parenchyma of the gland appears only here and there in

the spaces between the fat cells. A section of such a fatty gland, where the parenchymal cells have been stained red with carmine, therefore often has a marbled appearance even to the naked eye.

The glands have a rich vascularity; the origin of the vessels is mentioned above. Here one need only say that the arterial branches are mainly distributed along the connective tissue cords in the interior of the gland. There are usually rather numerous and large veins which both follow the arteries and also are distributed over the capsule of the gland or in the numerous furrows on its surface. The capillary net work which is very irregular in its form, lies in glands with a continuous parenchyma in between its cells without any surrounding adventitial connective tissue. In the reticular and follicular arrangement of the parenchyma the capillaries surround the cords and follicles closely following the surrounding connective tissue membrane. From the vascular network, thus lying mainly outside the glandular substance, single capillaries penetrate into the bigger cords and larger follicles, in which they probably just pierce the lining membrane. At least I have not succeeded even under the highest magnification in seeing any wall to these capillaries, which could be interpreted as a continuation of the *Membrana propria*. Concerning the form and density of the capillary net work I want to refer to Plate V, fig. 3, which I suppose will give a better idea of it than any description.

I have never been able to find any nerves in these glands. Even in those specimens which have been fixed in osmic acid and then examined section by section I have never found any trace of nerve tissue.

In my investigations I have also been looking for lymph vessels but as yet I have not reached any definite results upon this point. In the glandular parenchyma one may certainly sometimes see rather big irregular spaces with endothelial lining. The walls of these openings have a coating of a homogeneous substance, possibly coagulated lymph, and they might therefore possibly be looked upon as lymph spaces. As my attempts to make the lymph system visible by means of stained injections have not yet given any reliable pictures, a description of what I have observed in this respect may appropriately be postponed until further experiments have been performed.

Glandular organs of this kind also seem to be in common existence in other species as far as I can judge from the examinations I have made in this respect in dog, cat, horse, ox and rabbit. I have constantly found the glands in all these animals, although in most cases only one on each side and always close to the thyroid gland; and may I take the opportunity to describe here quite briefly the position and structure of the glands in these representatives of some of the larger families in the mammalian group of animals.

In the dog (Plate IV, fig. 2) and the cat (Plate IV, fig. 4) in which the thyroid glands agree rather well in regard to position and form, the glands in question also show a complete conformity in this respect. In each is found on the anterior outer surface of the thyroid gland, generally nearer to its superior border, a gland usually as large as a hemp seed and in its color somewhat lighter than the thyroid.[2] Although lying within the same connective tissue capsule as the thyroid, it is always clearly separated through a thin layer of connective tissue, wherefore it often has a certain degree of mobility against the latter. Its form is round or ovoid with the longer axis parallel to the long axis of the thyroid. The outer surface is generally flat, the inner surface more rounded. In the dog this rounded side corresponds to a small groove on the thyroid gland, wherein it is partly embedded. Its structure is less variable than in man. The cells are entirely like those in man. However, I have never found any deposition of fat or colloid in their protoplasm. In its arrangement the glandular substance always appears as one solid cell mass (see Plate V, fig. 1).

In the ox (Plate IV, fig. 3) it is not so easy to find the gland. Even in this species it certainly lies at the posterior border of the lateral lobe of the thyroid gland[3] or under its posterior inner sur-

[2] In the dog I have sometimes found the gland on the posterior inner surface of the thyroid gland.

[3] The statement of many handbooks that the thyroid of the ox should have no isthmus and consist of two separate lateral lobes is entirely false; on the contrary, there is always a bridge of glandular substance connecting the two lobes. However, it is often rather thin and in its whole length enclosed in fat, but still clear enough not to be overlooked, even in a rather superficial preparation. Easier to overlook is the isthmus in dog and cat because of the fact that it is there unusually thin. Whether it is quite constant even in these animals I am not able to decide from the small number of specimens I have examined.

face, in which case it does not become visible until the thyroid is loosened from the underlying organs and the posterior border is bent forward; however, it does not have its place close to the gland, but is separated from it by a more or less bulky layer of fat. When looking for the gland it is therefore best to loosen carefully the posterior surface of the thyroid, together with the posterior part of its inner surface from the underlying fat and then remove the fat with all precaution in small portions whereby one will soon find the flat 7-10 mm. broad gland, which in color is generally quite like the thyroid but sometimes has a faint touch of reddish-yellow. Its inner anterior border is often drawn out in a thin stalk sometimes up to 15 mm. in length, which, following the vessels to and from the gland, passes inward and forward to the thyroid. On first sight the gland seems to differ considerably in its structure from that of man and the animals examined (Plate V, fig. 2). The rather different arrangement of the parenchyma is striking. One will find it scattered in larger or smaller parts, highly irregular in their form and sometimes here and there connected with one another. They are separated by a rather rich interstitial connective tissue. Under low magnification these parts of the glandular substance in their turn seem to be composed of a network of thin cell strands winding around each other, a picture which on closer analysis seems to find its explanation in a thick net of capillaries distributed in the glandular substance with some connective tissue around them. The cells are somewhat larger than in man and have more protoplasm perhaps containing fine fat drops and now and then a brownish-yellow pigment. The intercellular net of keratin comes out with extraordinary clearness in the ox after treatment with chromic acid. Even quite weak chromic acid solutions (⅛ per cent) cause such a considerable shrinkage of the cells and a resulting clearer appearance of the intercellular net that on a comparison of a section from a gland fixed in this solution with one that has been treated with osmic acid or Müller's solution one would hardly recognize them as being pictures from the same organ. On one occasion I found in the center of the gland some alveoli entirely separated from the net of glandular substance. They were filled with colloid and in appearance similar to the alveoli of the thyroid gland.

In the horse also (Plate IV, fig. 5) we find a similar organ, which is here more rounded, 6-8 mm. thick, its color is sometimes like that of the thyroid, sometimes differing from it by a more or less yellowish tint. Its position is behind the thyroid, sometimes covered by its posterior border. The glandular substance shows a more or less advanced differentiation into lobules, cords and follicles which are separated by a very poor layer of connective tissue. The cells are like those in the ox, and often contain a brownish yellow pigment; especially in the cell clusters near the surface of the gland.

In the rabbit (Plate IV, fig. 6) the gland lies on the lateral side of the thyroid, sometimes at its posterior border. Its connection with the thyroid is maintained only by a very loose connective tissue so that on removal of the trachea and oesophagus one will often find the gland still adhering to the large cervical vessels, especially if it was originally located at the posterior border of the thyroid. Its form is either ovoid with its long axis parallel to the trachea, or it might even be more spindle-shaped; its color is usually somewhat lighter than that of the thyroid. The length varies from 2-5 mm. Sometimes I have found a smaller gland of the size of a pin's head in the fat on the trachea below the isthmus of the thyroid. The structure is often somewhat lobulated. The parenchyma within the lobules is usually one solid cell mass, penetrated by a fine-meshed net of capillaries; now and then one will find single follicles with formation of alveoli. The cells are distinguished by their fat content. In each cell one constantly will find a fat drop, often of the size of the cell nucleus. However, this fat seems to differ slightly in its chemical reactions as it does not take stain so intensely from osmic acid, although the fat character is unmistakable because of the optical qualities and the solubility in ether and volatile oils.

After the above description of the appearance and structure of these glands in man and several animals the question naturally arises to which type of glands already known in the mammalian organism these organs are to be related? The absence of any kind of tract for glandular secretion even in those glands where formation of alveoli may be seen, as well as the non-existence of the characteristic tissue components of the lymphoid organs make it beyond doubt that we must relate them to the so-called vascular glands, and with so much more reason if we consider their unusual vascularity. Among

the glands that belong to this group those under discussion might, at least with reference to conditions in man, coincide chiefly in their ordinary structure with that of the pituitary gland. However, some structural conditions that are only occasionally observed in man indicate a closer relationship to the thyroid gland, which relationship also *a priori* seems most probable considering their occurrence in the proximity of this gland. Both within the solid parenchyma and in the strands and clusters which it sometimes forms one not infrequently finds smaller cavities surrounded by glandular cells and containing colloid. When they have reached the size where the surrounding cell mass forms only one layer of cells, the similarity to smaller thyroid alveoli is complete; and when such alveoli sometimes occur in a smaller group along one of the borders of the gland, one may say that in this case a smaller part of the gland shows a complete thyroid structure. On examination of such preparations one might therefore quite easily reach the opinion that these glands could possibly be undifferentiated thyroid glands, and that consequently the considerable difference in structure which exists between them should have its natural explanation in their different degrees of development. In a question of this kind only a more thorough comparative study of the development of the organs may help to a decision. Let us therefore see if the facts hitherto known about the earlier development of the thyroid might give any support to the supposition mentioned above of the relationship of the two glands.[4]

We know from the investigations of Remak (2, p. 39) that the thyroid has its origin from the pharynx. As early as the third day in the chick embryo one may see a plain round bud from the epithelium of the anterior wall of the pharynx in the mid-line of the body; on the fourth day this bud begins to separate from the epithelium of the pharynx and at the same time becomes hollow, so that the thyroid anlage now appears as a vesicle which is still connected by a small stalk with the pharyngeal epithelium. The vesicle soon becomes solid again and at the same time the development of a sagittal furrow begins, which finally leads to the splitting of the glandular anlage into two lateral lobes. Out of the two solid cell

[4] The following description of the development of the thyroid gland is based on Kölliker's work in the latest edition of his "*Entwicklungsgeschichte des Menschen und der höheren Tiere*" (1).

masses that have thus separated from each other there has developed on the 9th day a net of primarily solid, cylindrical cell cords which on the 12th day show a narrow lumen with slight dilatations here and there. There are also a few rounded follicles. On the 16th day these follicles form the main part of the gland, but besides them there are still a few cylindrical, incompletely segmented cords. In the rabbit the development is, according to Kölliker (summarized): On the 9th day the epithelium of the anterior pharyngeal wall shows a thickening, which the following day takes the form of a cell bud and, still solid, on the 11th day loses its connection with the pharyngeal epithelium. On the 14th day the glandular anlage is still solid and without any signs of division, but from then on cell clusters begin to grow out which branch off and later become follicular. On the 15th day the gland consists of a single winding cylindrical cord which gives off branches often with bulb-like thickenings at the ends, that sometimes are hollow and some of which already at this stage have been detached from the main cord. During the following days the number of ramifications, which now in their turn give off branches, gets larger and larger, so that it is more difficult to see the plan for the structural arrangement of the gland. However, Kölliker maintains that the gland still consists of one single cell cord, even if it shows a multitude of branches, and he denies the existence of anastomoses between the separate cords, which condition Müller claims to have observed. It is through a successive segmentation of these cellular strands which are already hollow in certain places, that the follicles and alveoli are formed. At what time in the human embryo the processes begin, which initiate the development of the thyroid gland is not known. In two months old embryos the thyroid already has a thin isthmus and two lateral lobes. In this month W. Müller found the gland consisting only of cylindrical cell cords, while Kölliker at the end of the same month also found glandular vesicles. In the third month Kölliker found vesicles which by bud-like protrusions and their resulting segmentation seemed to give rise to new structures of the same kind.

Undoubtedly the thyroid gland in the different phases of its histological development shows a certain similarity to the respective forms of the glands in question as they appear in man. Certainly the development of the thyroid gland in man is still incompletely

known, but since the observations that have hitherto been made are quite in accordance with what is seen in the development of the thyroid gland in the rabbit, one might suppose with a certain degree of probability that the similarity also includes the stages in man which one has as yet not been able to observe.

The first stage of the thyroid development has, in the glands under discussion, its analogy in the form which is characterized by a solid cell mass.

The second stage of development seems on superficial inspection to produce a certain similarity to what I have called the reticular arrangement of the parenchyma. In both glands the cells are arranged in cords, but otherwise they show the difference that in the undeveloped thyroid gland the whole glandular mass, according to Kölliker, consists of one single cell cord, which is winding and gives off an abundant number of branches, while the corresponding stage of the glands I describe is characterized by a net-like mass of cell strands. The developmental mechanism for this kind of thyroid architecture might possibly be a proliferation of the glandular cells, through which the solid cell mass of the first stage is changed into a branching tree-like structure. But on the other hand in order to explain the reticular arrangement of the other glands arising from a solid cell mass one has to assume an active participation of the surrounding connective tissue; in other words that the connective tissue, by following the vascular net or perhaps by accompanying it during development, grows into the cell mass and in particular places breaks up the original continuity of the parenchyma. However, as already mentioned another conception of the structure of the thyroid gland has been advanced: according to W. Müller (3) it should also in this (the second) stage of development consist of a net-like mass of cells. If this latter conception be true, the analogy between the two glands could be supported even with regard to this phase of development.

The third stage—the formation of follicles—is also found in the glands I describe. Even the embryonic formation of alveoli, which partly precedes, partly occurs simultaneously with or later than the follicle formation, we have seen in the glands under discussion in all the different kinds of arrangement of the glandular parenchyma. Finally the colloid-metamorphosis, either directly from the cellular

protoplasm or from the contents of the alveoli, which is so often found in both glands, also supports an analogy between them; especially with reference to the vital capacities of the cells.

This agreement between the different stages of development of the thyroid gland and the glands under discussion and the diverse variations, as shown in their finer structure in different individuals, seem to me to justify us in looking upon the latter as embryonic thyroid glands; it ought to be remarked in this connection, however, that different glands in the same individual and even different parts of the same gland must have stopped in different stages of development more or less remote from the type which is the ultimate stage, i. e., the finished structure of the thyroid. But in certain places in some glands even this stage of development has been reached.

If, thus, the determination of the relationship in man between these glands and the thyroid gland is relatively easy because of the many forms which are analogous, this is far from being the case in animals, owing to the absence of such transitional stages. In the species of animals which I have examined no noteworthy variations in the structure of the glands in different individuals have been shown. As already mentioned I certainly have found a single alveolus now and then in the rabbit; but otherwise the structure of the gland in this animal, as in the cat and the dog, appears to be in approximate agreement with the first one of the forms that are found in man except for differences in the major lobulation. In the ox and the horse a spread and division of the parenchyma has occurred, but it has not advanced to the stage of the formation of characteristic alveoli. In these species, which are the only ones that I have examined, the gland I describe seems to have been arrested in one of the first stages of development, without even approaching the typical structure of the thyroid gland, as is the case in man.

If accordingly we have to consider these glands in man and in animals as likely embryonic organs, related to the thyroid gland, it remains to decide whether they have originally been combined with the thyroid anlage, and later on been separated therefrom in order to develop and grow independently, or if they, in the course of development, originally were independent of the thyroid and arose from the pharyngeal epithelium, even if close to, yet fully separated from the anlage of the thyroid. There can be no answer to this until

direct observations in this particular respect are made. Even regarding the possible time for their development we are entirely without information except in the following description by Kölliker in his *Entwicklungsgeschichte* (2, 2nd edition, p. 882), which may possibly have some bearing hereon: "In a rabbit embryo of 16 days the lateral lobe of the thyroid gland consisted of two parts. One of them was in its usual place, the other one was placed on the lateral side of the carotid, in front of the vagus nerve, and behind the uppermost part of the thymus." In such circumstances the time of development for the gland I describe would about correspond with that of the thyroid. That at any rate this development must be placed during the intra-uterine life is *a priori* acceptable and so much the more likely since the gland in two fetuses of eight months, which I have examined, proved to be fully developed and of the same structure as in the adult.

In the preceding description I have now and then mentioned the so-called accessory thyroid glands and I now want to refer to them in a few words, in order to prevent a possible confusion with the glands which are the subject of this paper. The above name is applied to the glands which appear near the thyroid, sometimes more remote therefrom, above the clavicle or below the styloid process, and which, although greatly variable in size and form, show the characteristic thyroid structure. Accessory thyroid glands are also found on that part of the thyroid where the glands under discussion have their place. Gruber (4) has named them *inferior* accessory thyroid glands when they occur at the inferior border of the thyroid and also *lateral inferior* accessory thyroid glands when they are situated at the inferior border of the lateral lobe alongside the trachea. These glands have thus a position corresponding to the inferior ones of the glands under discussion and according to Gruber they occur in 10 out of 100 cases. Even along the inner posterior border of the thyroid where this gland is resting against the junction between the pharynx and the oesophagus are they sometimes found (in approximately 5 out of 100 cases), and in this position they have been named by Gruber the *posterior* accessory thyroid glands. They here correspond to the superior ones of the glands under discussion. Accordingly they are organs occurring only exceptionally, and one would therefore be inclined to question whether or not these organs,

which in their structure entirely agree with the thyroid, are in their occurrence related to our glands in such a way that they represent a more advanced stage of development of the latter. If this be the case, one would expect to find one of the former where one has been searching in vain for one of the latter, or to miss one of the latter in a place where one had found one of the former. In this respect I can only maintain that in none of the cases where I have found an accessory thyroid gland have I failed to discover the glands in question, but I have also found both kinds lying close to one another, sometimes enclosed in the same fat lobule. The accessory thyroid glands are even located in places where I have never found any gland of the other kind.

Although both of the aforementioned kinds of glands could with equal reasons claim the name of accessory thyroid glands, a special name seems to be required for those which are the subject of this paper, both with regard to the essentially different structure and on account of the fact that this kind of gland is constant in its occurrence, while the other one is extremely variable. I therefore suggest the use of the name *Glandulae parathyreoideae*; a name in which the characteristic of being bye-glands to the thyroid is expressed. Furthermore the analogy to parovarium, paradidymis, etc., also gives an indication of organs of an embryonic nature.

Concerning the physiological importance of these glands for the organism, we are not able, from reasons that are quite apparent, to allow ourselves even to make a guess. But we might be inclined to attribute some importance to them in pathological conditions. In their nature of embryonic organs there is an etiological possibility for pathological growth processes, and if one considers how frequent are the tumors of the cervical region the etiology of which is completely unknown, these glands might possibly deserve some attention from the anatomical pathologists.[5] That there is evidence for

[5] Sometimes there occur on the surface of the gland quite small cysts hardly as large as a pin's head, the inner walls of which are coated with a very thin endothelium-like layer of cells and which contain a semi-solid, rather homogeneous and transparent mass, which not infrequently seems to be a conglomeration of larger and smaller incompletely united but uniform drops. Once I found the gland consisting of a nut-sized thin walled cyst, with a mucous content, unfortunately it was in such an advanced stage of decomposition that a more careful examination was impossible. It is to be remarked that in this case the thyroid gland did not

such an interest regarding the accessory thyroid glands is shown by a paper of Dr. Madelung under the title: "Anatomisches und Chirurgisches über die Glandula thyreoidea accessoria" (5). Probably one would find on a closer examination of the reasons which have been definitive in particular cases for attributing the origin of a tumor to an accessory thyroid gland, that it sometimes could with equally good reasons have been attributed to a parathyroid gland, especially if one considers that every individual has several glands of this kind, while an accessory thyroid gland is only found in one out of ten cases. For the purpose of diagnosing a tumor of a parathyroid gland I want to point out the proximity of the glands to the oesophagus and the recurrent nerve, whereby in cases of pathological growth process there may easily occur a compression of the former and a paralysis of the latter—a diagnostic sign which Madelung also points out in connection with a struma of the accessory thyroid gland.

While working on the above description of these hitherto unrecognized organs, I have tried to go through the older as well as the newer literature in order to find out whether these glands have been previously known and then forgotten again—but, unfortunately, the literature which I have had at my disposal has been too scanty and too hard of access for these studies to pretend to be complete. Therefore I must limit myself by citing in their own words two authors who seem to me to have traced the glands in question, although I do not want thereby to deny the possibility that even others may have observed them before me. In the *Untersuchungen über die Entwicklung der Wirbelthiere* (1) Remak says on page 191 of "Berichtigungen und Nachträge":

"Vor Kurzem fand ich bei der Untersuchung der Thymus neugeborener Katzen an der oberen Spitze der Thymus, woselbst in anderen Fällen auch Wimperblasen vorkommen, eine kleine gelbliche Drüse, welche weder mit der Thymus, noch mit Lymphdrüsen, noch mit der Schilddrüse in ihrem Bau übereinkommt. Sie besteht aus kernhaltigen, granulirten, gelblichen, locker neben einander liegenden

show any signs of struma. On one occasion I found amyloid degeneration in these glands. It had involved the walls of the blood vessels as well as the *Membrana propria* of the gland so that these structures were enormously thickened and had the characteristic glass-like appearance of this kind of degeneration.

Zellen von c. 1/150 L. Durchmesser, welche mit Leberzellen eine grosse Aehnlichkeit bieten."

Virchow (6) expresses himself more clearly in *Die krankhaften Geschwülste* (vol. 3, p. 13), after having mentioned the accessory thyroid glands at the upper border of the isthmus of the thyroid:

"Auch an anderen Punkten findet sich zuweilen abgeschnürte Lappen, isolirte, getrennte Theile der Drüse, die sich für sich weiter entwickeln und so der Ausgangspunkt einer strumösen Bildung werden können. Unter ihnen erwähne ich namentlich den hinteren Umfang der Seitenhörner, wo ich ausserordentlich häufig kleine, oft nur erbsengrosse, rundlich Knoten finde, die durch loses Bindegewebe mit der Drüse zusammenhängen und eher wie kleine Lymphdrüsen als wie Theile der Schilddrüse aussehen."

The investigations upon which this study is founded have been made in the Anatomical Institute of Upsala and I am greatly indebted to Professor Edv. Clason, Chief of the Institute, for placing the facilities of his Department at my disposal, and for the unfailing kindness and the vivid interest with which he has followed my work.

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